W T SHALL WE BECOME AFTER DEATH?

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ABBÉ MOREUX

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The second book appears under an extraordinarily misleading title. Being unfamiliar with the name of the author, we took it to be a work of pious meditations on the future state, and our surprise may be imagined when we found ourselves reading what is (we use these adjectives advisedly) a profoundly interesting and exceedingly valuable treatise *De Anima*. The author is well abreast of the problems of physics and modern views thereon, and it is from this standpoint that he discusses the soul, its immortality, and the nature of the resurrection body. He shows us how modern theories as to the intimate and ultimate constitution of matter have put entirely out of court the old mechanistic explanation of both living and non-living things. The admirable manner in which he does this might be commended to biologists, like the writer of the first-named book, who indulge themselves in much wider ideas as to the bearings of chemistry and physics on their subject, than do chemists and physicists, who, after all, are the persons who count in this matter. From this the author passes to the consideration of space—our space, which is of a three-dimensional order, and Hyperspace, which is, he thinks, at least four-dimensional. This part of the book is of the highest interest, for it is the first really successful attempt to make the bearings of this matter on physics, not to say on metaphysics, clear to an ordinarily intelligent reader. No philosophical student can afford to neglect this important book, and no library of philosophy will be complete without it. We commend it to the careful consideration of our readers.

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AFTER DEATH?

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Nihil Obstat

GEORGIUS CANONICUS MULLAN,
Censor Deputatus.

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By

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CONTENTS

CHAP. PAGE

I. THE GREAT RIDDLE 9
II. THE UNKNOWN UNIVERSE 16
III. MODERN CONCEPTIONS OF MATTER . . 24
IV. THE PHYSICS OF SPACE 39
V. THE UNCERTAINTIES OF OUR GEOMETRY . 49
VI. A STRANGE WORLD 59
VII. HYPERSPACE 69
VIII. SUGGESTIONS 79
IX. WHAT IS MATERIAL SUBSTANCE . . . 93
X. THE FAILURE OF MECHANICS IN BIOLOGY . 112
XI. THE SOUL 128
XII. WHY OUR SOUL CANNOT DIE . . . 142
XIII. AFTER DEATH 159
XIV. CREDO RESURRECTIONEM 180
XV. IS OUR BODY RENEWED 190
XVI. THE IDENTITY OF THE INDIVIDUAL . . 201
XVII. IMMORTALITY IN THE RESURRECTION . . 214
INDEX 233

What shall we Become after Death

CHAPTER I

THE GREAT RIDDLE

IN former volumes I have sought to guide my readers through the vast tracts of the visible Universe, and to explore some at least of its countless marvels. Wonder and mystery meet us at every stage of such a journey, and all fresh knowledge gained is a fresh revelation of Creation's splendour. In this book my purpose is to explore, so far as may be permitted, a yet greater mystery. A mighty Riddle faces you and me, and every human soul—the Riddle of what we shall be when the few years of this present life are over. What lies in store for us on the other side of the veil that we call Death?

Our death sentence is already signed. In a hundred and fifty years you who read these lines and I who write them will certainly have vanished from the face of the earth. Our relics, that came therefrom, will have returned thereto, the molecules of our body will still circulate, they will nourish plants, animals, perhaps other human beings who, like you, will seek the answer to the GREAT RIDDLE, the only one that really deserves our thought and study.

Reader, to-morrow you will die; you know it. This is the thought that haunts you at those rare moments when the restless life you lead allows you to think.

Look at the human race striving and struggling all the world over, like the perpetual motion of an ant hill. Everyone is born at his appointed hour; with lightning rapidity everyone hurries to perform a series of actions, most of which are merely conventional. Some travel round the world, explore mountains and deserts, rush to conquer the poles. Some construct machines of which others will make use. Express trains cross and re-cross continents, great steamships bring merchandise and passengers from the most remote ports. Night does not stop this perpetual activity; the lights are shining whilst, as if infatuated, men pursue their journeyings and their labour.

Where do they go? What are they doing? Ask that of Earth's two thousand million inhabitants; certainly they could not tell you. The most intelligent would answer that it is life. And after that? . . . the aim, the end of it all?

They do not care about that. They go at random, pushed on by a power they cannot resist, amused at every winding of the road, their eyes always fixed on the ground. Have they time to spare in this way?

" They go on to the final collapse and sink into the gaping emptiness of the unknown, falling with a loud cry of utterable dread. 'Oh! to die—why should we die?' " *

At every swing of the pendulum that marks a second gone, a man dies. And even that is not enough. Are there not wars to hasten this too slow

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* Cf. " Causeries " du R. P. Van Tricht, S. J. (Aug. Godenne, Namur.)

destruction? Every day almost a hundred thousand men are struck off the roll of the living. To-morrow, will it be your turn?

And then . . . You will no longer be on earth, but you do not doubt that the human race will still be pursuing its course to death. See how it swarms on this grain of dust that circles through space; each spring brings back a new wave of life: new sap invades all things; a restless activity takes possession of all beings. In the forest the branches shoot forth, the bird renews its song; the flocks increase; new couples prepare to consecrate their union. Death, which mows and thins the ranks, makes no difference, the survivors hasten to bury the corpses. One power calls to life, another to death.

"And when [the Lamb] had opened the fourth seal, I heard the voice of the fourth living creature, saying: 'Come, and see.' And behold a pale horse, and he that sat upon him, his name was Death . . . and power was given to him over the four parts of the earth, to kill with sword, with famine, and with death [pestilence], and with the beasts of the earth.*"

Death is indeed the Great Riddle that every man must seek to solve. In fact, the solution of this agonising problem determines the direction of our lives. If death is the end of all why should there be sacrifice, devotion, virtue? What matters to me the well-being of mankind in the future, if this well-being is in opposition to my own? Vices and virtues then are mere words; "the maximum of pleasure, the minimum of pain" must be the rule of my life. And (on such principles) human society crumbles away, for the entire mechanism of its interior life is based on maxims precisely opposite.

That is why we find the dogma of the future life, that is, of man's survival after death and of the existence of the world Beyond, at the base of all religions; a sacred dogma which all men have handed down to each other by tradition even at the epoch of the most complete barbarism. The Christian Religion, however, has alone known how to preserve the true idea of the future life.

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* Apoc. vi. 7. 8.

My aim in writing this book is not exactly to explain the grounds on which we rely in order to justify our assertions, simply from a religious point of view. We have often been accused of accepting our faith with our eyes shut, and without examination. That idea, which we find even among those who boast of being Catholics, arises simply and solely from ignorance of Catholic theology. Men who are reputed to be learned often have completely erroneous notions on this question, as the following authentic story proves.

The occasion was the maintenance of a thesis for the doctor's degree at the Sorbonne by a philosopher who afterwards became very famous. Whilst priding himself on his Catholicism, our philosopher had expressed ideas somewhat outside the dogmas of our Faith, and his examiner could not help remarking to him: "How, Sir, can you reconcile such opinions with your beliefs?"

To which the candidate replied: "I dwell in a house two stories high, faith occupies the first story, reason the ground floor, and there is no communicating stair between the two."

With all respect to the renowned philosopher, the stair must exist; I go further, and affirm that no contradiction is possible between science and faith; and since both have their source in God, the origin of all Truth, both must be the expression of what is true. But while faith, depending on testimonies coming directly from Him, could not lead us into error, our science—if not The Science—may quite well be imperfect.

We must always distinguish between what is proved and what is merely a scientific hypothesis, a more or less secure stepping-stone to help us in arriving at the truth.

Can true science teach us anything as to the survival of the soul? Cannot it at least help us, with regard to the conditions of the future life and the resurrection, by showing that there is no contradiction between Catholic doctrine and the modern theories of energy, motion, molecular physics—those conceptions which every day assert themselves in the light of serious scientific research?

This is the standpoint which I shall take in the following chapters. Let there be no mistake as to my object in this book: it is, before everything, a scientific work. Whilst acknowledging the doctrine of the Catholic Church and the scholastic philosophy, I have not sought to bring forward any fresh proofs of the immortality of the soul and the future state. I have no thought of writing a new apologetic; I shall penetrate as little as possible into the domain of philosophy; but since science makes progress every day, I shall allow myself to point out the limits which it has actually reached, and the territory which it legally occupies or will in all probability occupy in the very near future.

Having established the concord between faith and the new acquisitions of science, having demonstrated in any case the possible formula of this concord, I shall leave to the philosopher the business of recording the newly established facts and of extending his metaphysical inquiries.

The chief opposition of the old materialism and the modern positivism arises, it seems to me, above all from the denial of the human soul. In a world where everything is material, where power itself is materialised, there is no place for the Spirit—the Psyche of the Greeks.

The Soul, certain philosophers tell us, is a concept invented to meet the requirements of a theory. How can one conceive, they add, a substance which no one has ever seen, unextended in its nature, and which can have no place in a mechanical and material universe?

The fact is that neither Mechanics nor Physics need, for their application, precise notions of substance, that is, of substance in its essential meaning.

We can make use of electricity, and we do so every day, without knowing exactly in what it consists. Every day we measure the quantity of electric energy that we use; we invent instruments for determining volts, hectowatts, coulombs, etc.; and we pay the electrical companies for the energy we have used, according to a regular tariff.

Applied science can therefore content itself with mere labels without going to the bottom of things. Science itself must not so limit itself; it is chiefly concerned with seeking for causes, and that is why it touches at certain points the borders of Metaphysics. The ancients understood this so clearly that they included all sciences in Philosophy, a vast synthesis uniting all that human knowledge is able to approach. To wish to fix the borders of the territories reserved respectively to Science and to Philosophy is, really, to fall into a gross mistake which only ignorance can excuse.

But if the two empires interpenetrate, a mutual understanding is possible; there must exist at their borders a common zone where the truths admitted in one camp could not constitute irreducible antinomies to those acknowledged in the other. *Natura non facit saltus*, said the old scholastic; there must be a harmony, there may be a hierarchy, in the substances that make up the created universe.

And of what is that universe composed? Are we certain, with the means at our disposal, that we can reach its ultimate elements? Are we not surrounded by invisible beings, by mysterious powers, by substances unknown to our gross senses, but at the effects of which we guess? As a matter of fact, all the researches of science tend now-a-days to show us that what we see of the universe is as nothing compared to what our bodily senses are unable to discover in it.

Yet, according to the Apostle's words, we need to study the visible in order to arrive at a belief in the unseen universe and in the Creator Himself.*

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* "Because that which is known of God (i.e., which the natural reason teaches us concerning His existence and His nature) is manifest in them. For God hath manifested it unto them. For the invisible things of Him, from the creation of the world, are clearly seen, being understood by the things that are made; His eternal power also, and divinity."—Rom. i., 19, 20.

CHAPTER II

THE UNKNOWN UNIVERSE

ACCUSTOMED like an animal to live in a world which his senses reveal to him naturally, man has taken many centuries to realise that his conception of the universe, that is, the images with which his senses furnish him, correspond but feebly to its magnificent reality. In pursuing their studies and experiments the natural philosophers were led first to suspect, then to demonstrate, the existence of numerous phenomena unknown to men in general, of influences which affect our bodily nature only indirectly, which our senses cannot perceive and which only reasoning enables us to recognize.

It would therefore be absurd to deny the possible existence of a sixth sense. Persons both deaf and blind are not infrequently met with *; it is very evident that for people thus handicapped by nature the conception of the external world must be very unlike what it is to one possessing the faculties of sight and hearing. Is their conception false? By no means; it is only imperfect; that is to say, that one or many of the points of view which belong to us if we are normally constituted escape their knowledge.

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* Several cases of the successful instruction of blind, deaf mutes, such as Marie Heurtin and Laura Bridgman, have been brought before our notice in the last few years. But the great number of these unfortunates is not generally known : 500 in Germany, of which 223 are in Prussia ; 260 in Sweden : 533 in Great Britain ; 2772 in the United States ; 100 in France, etc.

A being with different faculties from ours would, therefore, perceive different qualities in our bodies; and in the same way a man endowed with a sixth sense could penetrate further into the nature of the external world.

But here arises a new question: Does this external world really exist as we believe we see it and as we picture it?

Let us study the mechanism of a sensation, no matter of what kind.

Here is an iron bar which I take out of the fire: if I touch it I receive an impression of heat, the cause of which I rightly ascribe to the object of which I feel the contact; I am compelled to attribute the heat to it; in other words, I carry back to the cause the effect produced.

Now, what do Physics teach me? That the heat in an object is by no means of the same nature as the effect produced in me. The hot bar gives me a scale of varying sensations; a rather pleasant sense of bodily comfort if I am cold; very little impression at all if its temperature scarcely exceeds that of my body; a painful sensation of burning if the heat of the iron bar is considerably higher than my normal temperature. Apart from its effect on me, what is the nature of the phenomenon? It is a mere molecular vibration; the molecules of the bar, or its atoms (it matters little which), vibrate more or less swiftly; according to the varying temperature I experience varying sensations. One must distinguish, therefore, in the heat supposed, the objective and subjective relations.

It is the same with regard to sound; outside of me a metal vibrates and within me I am conscious of a sound. For one lacking the sense of hearing nature would be a perpetual silence.

A still better illustration: I can conceive of a human being constituted differently from myself with respect to this sense Our ears are able to perceive vibrations from 32 to 32,768 a second—the consequence of a purely physiological conformation. An ear-drum otherwise constituted, with a different basilary membrane, would enable us to perceive other scales from 32,768 to 34 thousand million vibrations per second. All our instruments, violins, piano, flutes, etc., would leave such an ear insensible; and yet one who possessed it would not be deaf, but his sense of hearing would be tuned to perceive a music of which we have no conception. Now these vibrations exist in nature, but we do not perceive them for lack of a sense corresponding to them. There is therefore a whole category of facts that eludes our consciousness.

A man endowed with such an ear could hear the whole scale of electric undulations, from those communicated to us by the sun and stars to the hertzian waves produced by our instruments and the wireless telegraphic signals which we can now register mechanically. All these vibrations which our ears do not perceive would excite organs otherwise constituted; a man possessing them would not hear the thousand sounds of nature, as we hear them, nor the voice of his fellow-creatures, nor the music of our orchestras, nor the bird's song, but he would hear harmonies no less definite in every electric manifestation, from the song of the Aurora Borealis to the transformed voice of the spark and of the thunder. Our orchestras would be supplied by cells and dynamos, and their symphony registered far away and wirelessly by phonographs of extreme sensibility.

As to our sight, the least modification would result in a radical transformation of our conception of the external world. Instead of fitting our eye to perceive vibrations of about 400 or 700 trillions per second, the Creator could have given us a retina sensible of a yet higher scale. Suppose our maximum of perception to be about four or five quatrillions of vibrations a second; in this case all the colours would disappear. Externally, colour is simply a series of wave-trains of various dimensions reflected by the bodies on which they fall. But if the ether wave is of the same order of magnitude as the molecular interstices, the reflection does not take place; which is precisely what occurs when we reach the region of the X rays. In this region there is neither reflection, nor polarisation, nor refraction; the waves, of which the length is much less than the ten thousandth part of a millimètre, are not arrested by solid bodies; a prism is for such waves nothing but a rough mass of dispersed molecules which they traverse as the air passes through a wide-meshed net.

Let us look at nature with such a retina; what a *bizarre* scene confronts us! Our streets are peopled with strolling skeletons; nothing of flesh is visible; nothing of clothes but the metallic framework, buttons, clasps, corset-frames, boot-heels, and such things. Since the X rays do not pass through glass, all the shops appear to be closed, no show of goods is to be seen, and yet the skeletons stop to look at objects quite invisible to us. On the other hand, neither closed doors nor walls present any obstacle to our vision. The townspeople who think themselves quite private have their homes laid open to the gaze of our altered retina.

It is summer; let us explore the country. The whole scene is changed; instead of the green forest we see, so far as our sight can reach, a naked steppe stretching beyond the horizon. There is no trace of vegetation, the woods have disappeared, the fields are a desert. If we look more closely, we perceive the sap of the trees, like fine transparent threads, which if we try to take we find ourselves stopped by the bark, which we touch but which remains invisible.

If we return in the winter, we shall find no sign at all of vegetable life; we shall be obliged to grope our way through a labyrinth where at each step we run the risk of hurting ourselves against some murderous tree-trunk.

And if all the inhabitants of the world were thus made, nature would seem altogether different from what it seems to us at present. We should be compelled to shelter ourselves in glass houses with wooden panes in our windows. Our standard of beauty would itself be changed, and both our literature and art would feel the effect. Yet would not what we saw be real? Would an outer world not still exist? Evidently; but we should see only one aspect of the scene, just as now we only perceive what God, and our outward senses, allow us to see.

Mere fancy and imagination, do you say? Not in the least, as we can show you by examples. You know that some people's sight is not at all like yours. Most colour-blind persons cannot distinguish red from green or grey; others cannot tell yellow or blue, in a very few cases the retina is insensible to red, orange, green and violet. And who can assure you that you see exactly as I do, or as your neighbour sees? And if you distinguish plainly the colours which I distinguish, how can you prove that they are identical? By education and habit we have learned to discern and label colours, but nothing proves that *your* colours are the same as *mine*.

Do animals see nature from the same angle as men? We may well doubt it. How does the outer world appear to creatures possessing what were formerly called "composed" eyes, like those of insects? It was for long believed that the refracting and transparent cones which terminate their retinian "sticks" were so many lenticular pieces, each receiving a complete image, probably centralised in the cerebral substance. It has been found necessary to abandon this theory, but the problem as proposed, to-day, is equally insoluble. If each of these cones do not transmit an image, how can the resulting sensation give the shape of the object? Insects, it maybe, do not clearly perceive its form; and have only a confused sense of colour. According to Sir John Lubbock's very clever experiments, ants are sensitive to ultra-violet rays. Imagine a man similarly endowed; while another is plunged in gloom, he will be able to see a whole landscape brilliantly illuminated by a light unknown to our perceptions.

Let us pass to the other end of the visible spectrum, and imagine that our eyes are fitted to perceive the thermic vibrations revealed by the bolometer; the whole scale of vision is transposed, and instead of only perceiving the stars which our present sight can discern, we shall see stars long ago extinct, black suns which only the spectroscope can reveal. Our own sun will appear surrounded by an immense halo variable in form and position, and that mysterious aureole which we can only see at great cost during total eclipses we shall perceive whenever we turn our eyes to the radiant luminary. The warm air currents will become as visible as our blizzards, and the science of heat will no longer have any secrets for us.

Do beings, as they are developed through geological periods, pass through a more or less great scale of vibrations; are our senses refined by such exercise; do they undergo transposition to some extent? Would the influence of other surroundings give rise to organs adapted to other undulations? There are so many questions which science can propose, but which it is incapable to solve. We live in the midst of mystery; Nature appears to us such as God wills us to see it, and the "windows" (to borrow the expression of Leibnitz) through which our soul looks to the outer world are neither many nor wide open.

If Philosophy teaches us that in some sense we build up the external world in conformity with our sensations, the Natural Philosophy of to-day has shown us how incomplete and fragmentary that conception is. The Creator's works are even more beautiful than we can imagine, and in this life our soul, as yet chained to the body, must content itself with seeing only a very little part of that marvellous picture which we call the Universe.

So every man who studies nature without prejudice must reason, but it is a fact that in every age science, usually without intending it, has furnished philosophers with arms on the side of unbelief. Not content with discovering in our sensations some degree of subjectivity, many minds, renewing the Pyrronhic speculations, have enquired whether subjective phenomena have any correspondence with objective reality.

"Our sensations exist," say the idealists and subjectivists, "there is no doubt about that; in fact they force themselves upon us as the only evident reality; but who can say that these states of consciousness, as we call them, have not their sole origin and cause in ourselves? In a dream does not the sleeper evoke a whole world of fancies, of the real existence of which he has no doubt? And who can prove to us that our life is not a dream? The external world may quite well be a mere delusion."

Once having set out on that perilous way, modern subjectivists have not hesitated to go as far as to assert positively that the outer world does *not* exist.

Yet the argument is specious rather than real. If the sensations I experience arise only from interior modifications, without connection with exterior things, the phenomena which take place within myself would be inexplicable. Shut me up in a dark room: that will not hinder me from reviving at will sensations which I have already experienced. Even in the full light of day I have only to shut my eyes to see again a house I know; I can suddenly change the scene, and picture a friend's face, a sea view, a Swiss landscape, and so on.

As this diorama unrolls before my mind, as this cinematograph film passes before my eyes, I have the impression that it is produced by my will: I construct the film and direct it as I please.

It is not the same thing if, with my eyes open, I am taken bodily and set down before Notre Dame de Paris. I cannot choose but see the mighty building; if I continue my walk I see the Seine, its boats and quays, this or that street of the great capital.

Here are two perfectly distinct orders of phenomena which the idealists cannot explain. Willing or unwilling, unless we deny the relation between cause and effect, and suspect the essential witness of our consciousness, the world outside ourselves forces itself upon us. I may ignore the question as to what the "not-myself" consists in if I do not go to the bottom of the problem; but the fact that it *does* exist forces itself on my mind; it is distinct from myself, independent of myself; it compels my recognition in spite of myself, and depends on a cause which lies outside me and which I call the external world.

If then the man of science, comes and tells me how different from reality is the object I picture, that is his affair and I can discuss his opinions; but what really matters to me is to know that I am not alone, but that I form part of a whole which we call the Universe.

Possessing that acquired and certain conviction I can listen to the teaching of the natural philosopher and the chemist as they talk learnedly of matter.

CHAPTER III

MODERN CONCEPTIONS OF MATTER

TO understand thoroughly the answer that science gives to the question, What is Matter ? it would be necessary to trace step by step the conquest of the human mind in every branch of knowledge.

"To consult the past," says Alexander de Humboldt in *The Cosmos*, "is to follow the mysterious succession of ideas by which the same image, which at first appeared as a naturally harmonious whole, reaches at last complete clarity, thanks to long and laborious study."

Alas! our science is still far from having dispelled the shadows that obscure the knotty problem of matter. Will Physics and Chemistry ever succeed in penetrating to the ulterior basis of material substance? We may well doubt it, notwithstanding progress in this direction. At this moment we find ourselves at the same point as the ancient philosophers, the doctrine, that is, of the unity of matter. "Although the Church has defined nothing as to the state of matter at the time of its creation, the Catholic tradition has been unanimous in regarding matter as one from the beginning."* "Most interpreters," says St. Bonaventure in summing up the tradition on this point, "have seen in the words 'In the beginning God created heaven and earth' the substantial unity of all visible things ; one must infer from this that all bodies, celestial and terrestrial, have been produced, as to their being, from one and the same matter." Under the influence of this conception the alchemists of the middle ages endeavoured to accomplish the transmutation of metals. The basal idea of this was not so bad as it seems at first sight, but it was pressed beyond reason, and its votaries even went the length of imagining that a substance might exist capable of turning everything into gold—the Philosopher's Stone. But at the dawn of the nineteenth century, at the time when Lavoisier's chemisty led the funeral procession of the old scientific beliefs, the Philosopher's Stone, with the squaring of the circle and the theory of perpetual motion, were relegated to the museum of legends.

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*"D'ou venons-nous ?" Par l'Abbé Th. Moreux, p. 23.

All natural bodies have been reduced to associations of distinct elements, each endowed with special properties. The notion of simple bodies, unalterable under the most various reactions, seems to us now, after scarcely a century, to be built on a very frail foundation. Have not our chemists more than once found by analysis that bodies supposed so simple were composed of various elements, known or unknown? When will they stop in this direction?

Meanwhile Dalton and Prout have put forth ingenious hypotheses tending to show that all simple bodies are composed of parts still more simple: molecules or atoms. This theory, which is generally accepted, was such as to lead clever men of science to the modern theories of heat considered as a "mode of vibratory motion." Chemists, in their turn, soon realised that the weight of atoms does not depend upon chance; there exists between them such relations that all our elements appear to be derived from each other, so that we may foresee the time when science will be able to tell us the primary element, the myriad combinations of which have produced all material substances.

Astronomers had in fact long ago suspected the unity of matter. While we have proved that in the nebulæ there exist rare elements, such as helium, hydrogen and two or three unknown substances, ("nebulium" amongst them), the stars of an age more or less advanced presented to us substances of which the number increased in proportion to their condensation and refrigeration.

Whence could such a phenomenon originate? It was hardly possible to suppose an interchange of material between celestial bodies separated by unrealisable intervals of space. The newer bodies were therefore formed at the expense of the older, and the study of radio-active bodies confirms more and more this statement as a true genesis of the elements.

Thus everything tends to the belief that matter is everywhere composed of like elements; in a word, that the stuff of which this vast universe is formed is made of an absolutely identical tissue. Moreover, the latest scientific discoveries lead us to think that there exists a single substance, the ultimate particles of which, combined together, are the origin of all known bodies.

What is this substance? At present this matters little to us, but it is interesting to realise the bulk of the ultimate particles at which men of science can arrive. Abbé Haüy, the founder of modern cristallography, suspected the extreme divisibility of matter. He succeeded in obtaining a sheet of mica of the thickness of one 43rd millionth of a millimètre. To be sufficiently precise, it has been found possible to fix the number of atoms contained in a pin's head, this number is represented by the incredible figure of 8 sextillions, expressed arithmetically by the figure 8 followed by 21 cyphers. If we could detach them at the rate of a millon a second, we should need 253 millions of years to count them all.

But we can give nowadays better examples than these. The spectroscope reveals the most infinitesimal quantity of salt in an atmosphere; a fraction of a milligramme divided into three million parts suffices for the spectrum to show the yellow line characteristic of sodium chloride.

To these infinitesimal measures our sense of smell is as sensible as our artificial instruments; one hundreth part of a millionth part of a milligramme of iodoform produces a sensible odour.

Curie's electroscope enables us to detect the presence of the thousand millionth of a milligramme of radium. "If a milligramme of radium, then," says Sir William Ramsay,* "were distributed among the two thousand million inhabitants of the world, each would possess sufficient to discharge five electroscopes, and thus be able to study the most important terrestrial properties."

We have travelled far from the ideas of the ancient natural philosophers as to matter; the study of radioactive bodies will now reveal yet other marvels to us. One was formerly accustomed to consider the atom † as inert matter, mere support of energy so to say, the receptacle of a mysterious and unknown natural force. The modern conception is entirely different. Modern men of science, with Lorentz, Larmor, and Zeeman, consider the atom as a world in motion as complicated as our solar system. The constituent particles of a body are therefore no more regarded as "atoms" in the sense of "indivisible."

Let us take an atom of hydrogen as an example. It may be considered as an agglomeration of about two thousand particles; that is to say, around a (comparatively) large body, positively electrified, turn about two thousand small bodies, negatively electrified.* Let us suppose that system magnified to the size of a church; our two thousand electrons (as men of science term the negative corpuscules) would be represented by grains of ordinary sand rotating with a giddy velocity.†

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* "Elements and Electrons," (Harper, London.)

† The word is here used in its etymological sense, as an ultimate indivisible particle.

The Sun has a diameter of about a million and a half kilomètres, while our smallest planets possess one of scarcely twenty-four; if we imagine a hydrogen atom of the magnitude of the Sun, our electrons will be at the utmost only two-thirds of the asteroid's size. The atom then is a true solar world in miniature, each planet of which turns rapidly round its sun, at the same time revolving on its own axis.

Such considerations concerning the infinitely little, no less than with regard to the infinitely great, show us once more how *number* governs all things; that, according to the Biblical expression, God has created all things "in weight, number, and measure."

We live then in a world of which we do not realise the complexity. The air you breathe, the dust of the road you tread, this paper I write on, are all composed of hosts of molecules, vibrating and travelling at an incredible speed. Our bodies themselves, which are formed of material corpuscules, consist of a stellar system a thousand times more complicated than the milky way with its millions of suns.

And when we realise that all our physiological actions tend to one end, are ruled by infallible laws of unity and harmony, we are the more disposed to conceive the existence of a Creator Who has invested us with a mysterious power capable of ruling these billions of planetary systems that compose our mortal coil. Atomic astronomy should form a new branch of celestial machanics, a new scientific department awaiting its Kepplers and its Newtons. In fact the new knowledge has set before men of science and mechanicians problems which, scarcely forty years ago, no one could suspect.

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* Abraham et Langevin: "Les quantités élémentaires d' électricité: ions, electrons, corpuscules" (Gauthier-Villars, Paris).

† Sir Oliver Lodge: "On Electrons."

"Like flies in a great cathedral"

We have seen what complexity is involved in the structure of the atom. We shall now press the question more closely, and extend as far as we can, our enquiries as to these mysterious entities discovered by modern physics.

For a long while and for excellent reasons men of science had distinguished between the various forms which matter can assume. Matter was either *ponderable* or *imponderable*. What does that mean?

On the one hand, that matter could be submitted to the action of gravity and reveal a certain weight measurable by instruments of precision; such *ponderable* matter are the particles composing the bodies with which the chemist deals: iron, silver, azote, hydrogen.

But by the side of that weighty substance it had been necessary to imagine another, penetrating all bodies, capable of passing through all their interstices, a kind of *imponderable* medium, having no effect on our scales, transporting light in the form of vibratory motion through the interstellar space, communicating movement to atoms, the intangible support of energy. It was called *ether*, and its strange properties at first led to the supposition that no connection was possible between the two states of matter.

The relations between them were doubtless only those of juxtaposition or reciprocal action caused by an otherwise unknown agent. This newly discovered and eminently elastic medium bore much resemblance to the old "fluids" of natural philosophy, and many men of science tried to penetrate into its essential nature. But it was reserved for the science of our own day to discover the probable bond between ether and the bodies we call ponderable, and the study of electricity has disclosed new horizons of knowledge.

Let us look back a little way. Long ago Faraday had been led by his experiments to suspect the non-continuous structure of electricity, and the existence of a kind of natural unity (which was named the *electron*) in electric phenomena came gradually to be admitted. At once the atomic theory, which had proved so fruitful in Chemistry and Physics, invaded the domain of electrical science. Experiments revealed with regard to electrons properties at once obvious and wholly unexpected. They are the smallest corpuscules that pass through the atoms, for instance, of an iron wire, when we verify the presence of a current in it. Imagine the air molecules moving among the trees of a forest, and you have an idea of the movement of the electrons within the atoms of ponderable matter. Their velocities, which are ingeniously measured, are considerable; 100,000 kilomtères a second for the electrons forming the cathodic flow in Crookes' phials: 236,000 for those forming the *Bêta* rays of radium.

Is it possible to assign a magnitude to such infinitesimal corpuscules? All depends on the circumstances of production: we have seen, for instance, in the atom of hydrogen, which is one of the lightest substances we know, the size of the electron is at least 2000 times less than the atom itself.

And now, of what nature is the force supporting the electrons—ponderable or imponderable? That is a new question, the solution of which tended to disclose to men of science the most mysterious avenues of knowledge, and to make us suspect what seemed the most securely established doctrines of mechanics.

Every material body, we know, makes various impressions upon our senses which enable us to recognize it and to distinguish it from other bodies. Yet no one confuses the *phenomenon* with the *substance* which is its cause.

Take an orange, for instance, it is soft to the touch, it possesses a certain smell, its colour is characteristic. A scientist will tell you that the colour is but a vibration, caused no doubt by the orange, and transmitted by the ether to your sight, but distinct from the orange itself. If the colour were withdrawn, the orange would yet exist. In the same way the smell is not essential, nor the elasticity of the fruit ; the substance of the orange is hidden beneath the phenomena. What then remains ?

Your understanding tells you that everything is caused by something. What is the nature of this *something* ? About that you know nothing. Obviously there is a cause, a substance, a *substratum*, on which all phenomena depend, but you cannot penetrate into its essential nature. The same man of science will, however tell you that beneath these accidents there is something that remains and which is accessible to our senses.

That which remains is the *mass* of the orange. The mass is, so to say, the quantity of matter proper to the orange, and that quantity represents a measurable value.

How is this ? We will proceed to explain it. When a ball at rest begins to move we say that some force has acted on it so as to impart a certain velocity. Now experience tells us that the greater the force, the greater the velocity. If the force, measured by gravity, amounts, say, to one kilogramme, a force of two kilogrammes will give double the velocity. Therefore the measure of the velocity, or displacement, gives the measure of the force, and there is a constant relation between the force and the imparted velocity.

Whence does that relation arise ? Evidently from the body which always opposes the same resistance to the displacement. That resistance, one can easily see, depends upon the quantity of matter to be displaced. The relation thus established is the *mass**; it is independent of all the conditions of the matter displaced, it measures the matter itself which is contained in the body; in other words, it measures what natural philosophers formerly termed its *inertia.*

Now, if all accidents—sound, colour, smell, elasticity, and the rest—are removed, what remains is the mass, indicating the substance. The mass is something intangible, then, but something that enables us, to a certain extent, to reach what supports the phenomena—i.e. the substance itself.

Such was the reasoning of the ancient natural philosophers, which you will still find in all standard text-books. The new theories of matter on the contrary tend to destroy that foundation, apparently so solid. According to these, the mass, that last shelter of the substance itself, would be nothing more than one more accident added to so many others; far from being invariable and independent of velocity it would itself be but a fanction of that velocity. In other words, the same body would not always oppose the same resistance to external forces; the inertia of matter, a word without meaning at least for the present, would be wholly a phenomenon of electricity.

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* The idea of the *mass* is easily deduced from simple formulæ; Mechanics demonstrate that: When two or more constant forces work successively on the same body in motion, they communicate to it simultaneously accelerations of velocity proportional to themselves.

Thus if we have : $\genfrac{}{}{0pt}{}{F}{\gamma} = \genfrac{}{}{0pt}{}{Y}{\gamma^1}$ F and F^1 are the forces. γ^1 and $'\gamma^1$ are the accelerations.

Then : $\frac{F}{\gamma} = \frac{F^1}{\gamma^1} = \frac{F^2}{\gamma^2} \; . \; . \; . \; . \; = M$ which is constant.

This constant is the *mass;* it is the relation between the force and the acceleration which it communicates to a body in motion.

In truth, the standard Mechanics go quite adrift on the point. Men of science should long ago have suspected this. What is a force? Should we call it that which is capable of making a body pass from the state of rest to that of movement, or of modifying an already existing movement?

But that definition certainly defines nothing, it mistakes the effect for the cause. What is the cause itself? And how can force *superimpose* itself upon matter, *add itself* to a substance?

The definition, it is easy to see, is insufficient, it does not go to the root of the matter. Would not that force rather be part and parcel of the substance itself? Very probably.

However that may be, we shall see by what necessary inductions scientists have been gradually driven—that is the word that expresses the fact—to suspect that they were on a wrong road, and that our experimental mechanics become manifestly important when applied to the solution of electrical phenomena.

Let us imagine a tiny electrified body—an electron—travelling through the ether. It is now possible to demonstrate that this little body charged with electricity is equivalent to a current in proportion to its velocity. But every current gives birth to a magnetic field of an intensity equally proportional to the same velocity. In order therefore to maintain our electron in motion there must be communicated to it an amount of energy greater than in the case of a non-electrified moveable body. Do we not know, in fact, that the birth of a magnetic field causes the phenomenon of self-induction which opposes itself to the current in the particular case before us, *i.e.* the motion of an electron? All happens as if, by the fact that it is electrified, our little sphere had increased in bulk—as if to the original mass there was added a mass of electro-magnetic nature. It is easy to demonstrate that this apparent mass, which varies with its velocity, increases indefinitely when the speed of the electron tends to approach that of light; whence arises the unexpected consequence that the work necessary to impart to an electron that velocity of 300,000 kilomètres a second would be infinite. It appears then impossible to obtain speeds greater than that of light.

On the other hand, M. Kauffmann, by his experiments on electrons with speeds varying from 210,000 to 300,000 kilomètres a second, has proved that according to Max Abraham's theory, the mass depends entirely on the velocity and increases continually as the velocity approaches that of light. Whence we conclude that the whole apparent mass is equal to the electro-magnetic mass. Thus the material mass of the electron, that last particle of matter, is equal to *naught*—it is purely electric.

We will not stop half-way, but proceed to consider all the consequences of this statement.

The electron, which the facts first led us to conceive as a particle of electrified matter, 2,000 times lighter than an atom of hydrogen, must be regarded as a single electric charge without ponderable matter; an infinitesimal speck of ether endowed with special properties and floating itself in the bosom of the ether with a velocity which can never reach that of light.

This theory, which is more than a mere hypothesis, has taken an acknowledged place in science. Thanks to it, we are now able to interpret satisfactorily the phenomena of electricity, magnetism, and light. The phenomena of gravitation alone, in spite of the boldest attempts, remains almost impenetrable. To explain them, as we shall see in chapter viii, one must have recourse to very recent mathematical theories.

At this point we put our finger on the relations between experimental Physics and Analysis; we realise that to catch a glimpse of the explanation of phenomena, the human intellect must use all its efforts in every branch of knowledge, accomplish a vast synthesis, and avail itself of all the progress made in the most various fields of research.

Yet we anticipate that our conception of the external world is generally inadequate. Matter, in fine, may be essentially active, and not enclosed in an inert support which cannot logically be imagined. In other words, it may be that we perceive, of the material substance, only what characterises it to our eyes—the force, which is the only reality within reach of the senses and which manifests the substance.

This line of thought will lead us gradually to understand better the existence of forces non-material and unextended, of pure spirits, angels, the human soul, of God Himself. But let us not anticipate; let us sum up briefly the electronic theory of matter for the sake of readers who have been unable to follow the technical developments previously explained.

We must certainly admit with Lorentz and Larmor that all matter is absorbed in ether; it may be that all material bodies consist of a mass of electrons. The atom of the older chemists is thus found to be a quite complicated formation; it is formed of a centre (a "positive *ion*") about which, to tell the truth, we know very little indeed, and which may be only an aggregate of conjoined particles and a variable quantity of negative electrons possessed of great velocity and ranged around the central mass, something resembling, yet sufficiently unlike, the dust composing the ring of Saturn which circles round that huge planet.

These solar systems in miniature are not stable and appear to be subject to a law of evolution and mortality. As they grow old they gradually lose their electrons; slower or swifter changes take place in the atom, which appears, in fact, to change its nature.

These phenomena, almost imperceptible in ordinary simple bodies, become, however, capable of clear statement in radio-active bodies. Thus is produced, sooner or later, a kind of evaporation of matter by return to ether. It is this curious fact that M. Gustave Lebon once called, if not with scientific precision, "a real *dematerialisation*."*

We could now discuss the essential nature of the ether atom, that ultimate particle of the matter of which we have caught a glimpse through the prism of our inferences with regard to Physics. We will return to that subject when the time comes. For the present it is enough to state that all recent researches tend to show that energy—*i.e.* force—constitutes the only reality accessible to our senses. However paradoxical these conclusions of experimental Physics may at first sight appear, we must register them as deductions rigorously inferred from observed facts.

Here is a whole range of conclusions which I much fear will not be relished by materialists. Those who claim to demonstrate the emptiness of our spiritual conceptions at every step of their deductions from Mechanics and Physics see their erroneous notion of matter crumble to nothing before their eyes.

But, it will be objected, will not the new system at the same time rejoice the idealists and the subjectivists? Not at all. For these, the world outside ourselves does not exist. Our sensations are reduced to *states of consciousness* in no relation to exterior causes. Here the folly of idealism begins.

We have briefly explained in the last chapter how we can be certain of the existence of the external world. Phenomena occur within us which idealists would be incapable of explaining by their system; phenomena which lead us to the evident, necessary, indisputable notion of that-which-is-not-myself. It is therefore easy for me to express to myself, accurately, if inadequately, the way by which I am led to realize my environment.

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* Dr. G. Lebon: "L'Evolution de la Matière." (Flammarion, Paris.)

In this present life I experience modifications of my *ego*--impressions, sensations—which inform me of the reality of external causes independent of me and of my will. That external world, my deductions tell me, is complex, consisting of manifold causes which act simultaneously upon my being. All these causes I find in my own body and of its nature, and it, again, appears to me to have relations with the outer world.

Moreover, this body which belongs to me appears to me as in some degree external to myself, who see and touch it. It participates therefore in external nature by its physical qualities, though I am conscious that it is to some extent subordinate to me and distinct from the things I would describe as "more external" to myself.

Science having shown me the complexity of matter, led me first to conceive of it under the aspect of atoms, infinitesimally small and of a constant mass. But scientists gradually taught me to consider the mass of the ultimate material particle as depending on its velocity, and finally, instead of being a receptacle of energy, as the energy itself, a force that is in fact the only reality of which our senses can take cognizance. The instrument at my disposal—my body—for conceiving the idea of the universe, not adequate but exact in spite of the limitations of my senses, is itself a material whole in constant relation with the forces around it. My sensations are but the perceptions of this relationship, which, so far from embracing the whole scale of the possible, shows me only a part of the causes which incessantly influence and modify nature.

Just as a man wearing yellow spectacles will see all colours mingled with this tint, so in our present state we only know of nature what our senses permit us to discover.

No relation between created things appears to me to be necessary; I can imagine these relations to be other than they are without destruction of the universe; and I can easily conceive that an Almighty Being could at this moment change instantaneously this order of things which is simply contingent.

Our natural sciences are therefore, by their very origin, chiefly experimental, and can by no means claim to be absolute. Moreover, these considerations remain true, even if instead of resting them on the conception of a Divine Creator, I merely consider created things in themselves. The relations between the forces acting according to known laws lose their character of necessity, so soon as I conceive the simple possibility of other conditions of existence.

Thus, which ever way we may look, all our sciences depend to a certain extent on experience. Arithmetic only, the science of number and quality, can be styled an exact science in the sense that it is necessary, and a different arrangement of the universe would change nothing in its theories and its corollaries.

You will ask, does not Geometry share the same prerogative of an exact science?

Wait before you decide this. We shall soon have the opportunity of examining the value and the scope of its assertions.

CHAPTER IV

THE PHYSICS OF SPACE

THE ancient theory of atoms encountered many difficulties. If the atom, whatever its size, is the ultimate element of matter, it is by the very definition indivisible. It must then be considered a hard non-elastic body; but the doctrine of the conservation of energy contradicts that conception.*

Let us now consider the recent scientific discoveries. Each atom, the size of which is probably less than a half-millionth of a millemètre, is itself composed of a vast number of particles—the *electrons*. These, in consequence of their unheard-of velocities, can set in motion the ether in which they come and go, and this latter transmits the resulting impact, in the form of undulations, to our senses. The atom thus recovers its necessary condition of elasticity, since it is at every moment changed in shape, and capable of such change, owing to its multiple composition. But that merely puts back the question. What does the electron become? One thinks to elude the difficulty by saying that the ether is an elastic, continuous medium, not formed of separate particles; in fact, that the ether constitutes space.

Very well: but the scientists themselves admit that the ether is not homogeneous. The proof of that is that agglomerations of ether give rise to the atoms of ponderable matter.

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* This question will be studied in chapter viii.

In the main this solution is simply fallacious. If the ether forms condensations, if its density varies, we must enquire the cause. If it condenses at certain spots, the neighbouring space must be rarified ; there is a displacement of something from one spot to another. This "something," what it may be I know not, filled a certain place ; what substance now fills it? Nothing, you will say. Then the vacuum exists, and there is no longer continuity : yet if "nothing" touches the ether particles they touch each other, and we cannot escape a dead-lock. If there *is* continuity, the mystery is still greater. Our atoms are in fact indivisible, or give rise to an elastic medium.

Thus we are compelled to conceive of a non-continuous ether, composed of atoms which, like those of our bodies, change their places with real velocities, according to the needs and the formation of the bodies concerned. But from the metaphysical standpoint this is no explanation, and we come back to the fundamental problem of space and matter. Whether we like it or not, we must return to the idea of particles as minute as you will, but distinct from one another.

Here the difficulties begin again. Are these particles extended or not? Philosophers, as always, will divide themselves into two camps.

Some admit that the ultimate particles of matter are unextended : from the standpoint of space they reckon as nothing.* But a series of cyphers could not give any result except a cypher. Multiplication of cyphers of space could never give any real space-quantity.

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* This is the hypothesis maintained by Leibnitz and his disciples, revived by Boscovich in the middle of the eighteenth century (*Theoria philosophiæ naturalis reducta ad unicam legem virium in natura existentium*), and adopted by savants of the first rank under the name of *Dynamism* ; among these last may be mentioned Ampère, Faraday, Cauchy, De Saint-Venant, Dugald Stewart, Cousin, etc.

Our philosophers will reply that those unextended particles are separated by intervals;* but here arises another difficulty: between these particles there can only be vacuum, unless we admit that space is something *in itself*. If there is a vacuum—that is if nothing separates the particles, these must touch each other: which contradicts the hypothesis; and if space is something in itself, what can it be?

It is difficult to imagine a space without properties, a space which would be neither accident nor substance, or else a substance having purely negative qualities. To deny a substance all possible properties is surely to assert its non-existence; such a substance would be pure nothingness.

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If we cross to the opposite camp we shall find ourselves in another labyrinth of contradictions. Let us admit that the ultimate material particles are extended: now no one can conceive an extension, however minute, that is not capable of division. But the champions of this side remind us that atoms, by the very definition, are indivisible. Quite so; but they should give us the proof instead of begging the question. Even without supposing that atoms enjoy the curious property of vanishing when divided—which seems altogether incomprehensible—I can conceive mentally a half, quarter, or millionth part of one, if it is extended, that is, divisible. I cannot divide it, I grant; but I can conceive of a being more powerful than myself being able to do so. In any case, I cannot reasonably deny the possibility. Where is that possibility to stop?

It is said that the problem amounts to dividing a straight line into an infinite number of parts. A fresh illusion: such a solution is impossible, even contradictory. If I accept the hypothesis that my line contains an infinite number of parts, a double line would contain twice as many. The second number would be greater than the first, which we have assumed is infinite. Therefore the first number is not infinite; and the same reasoning holds good for as many times as you please.

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* This is what Boscovich, for instance, said in order to escape the difficulty. That theory has been revived, though slightly modified, by Père Carbonnelle in his work: "Les Confins de la Science et de la Philosophie."

Other examples, taken from arithmetic and geometry, show the faultiness of the theory. Suppose any circumference whatever; how many parts, or points, does it contain? An infinity. Then suppose radii uniting every point to the centre; they will equally be infinite in number. Now let us draw a second circumference concentric with, and twice the size of the first. It should contain a double number of points. The radii in contact with each other on the small circumference will also be in contact on the second, but their number will be doubled and yet will be infinite—a contradiction in terms. Let us go back to the straight line.

" How many points," once Zeno of Elea, or perhaps it was some other philosopher, asked, " do you imagine to exist between its extremities, which I will call A and B ?" (Fig. 1)

A——————————————B

Suppose his pupil to answer: " An infinity."

Let us now suppose a body in motion along the line from the point A. There are only two possible hypothesis.

Either the moving body will take a definite time—say a second—to pass from A to B; it will then arrive at B after an infinity of seconds, that is, never; which is absurd and contrary to experience.

Or it will take no time (0 time) to pass from A to B. But $0 \times 3 = 0$, and 0 × by as many seconds as you like will always produce 0. Therefore it takes no time at all to pass from A to B. That means that it is already in B while still in A. Movement then does not exist, which is contrary to our daily experience; or else the interval which separates A from B does not exist, which is no less absurd.

Thus if, cost what it may, we refuse to reject the dilemma, we come to deny the reality either of movement or of space. But is it really a dilemma? Could we not conceive another method of interpretation? The fact that we reach a conclusion contrary to what actually occurs in nature is enough to warn us that we are on a wrong road. Zeno never succeeded in solving this problem, and many other philosophers have equally failed to solve it.

Suppose, said Descartes, a line extending to infinity in both directions; how many yards or inches will it contain? An infinity—let us say, for greater convenience, of mètres and décimètres. But if the number of mètres is infinite, the number of décimètres will be ten times as great; therefore the first number was not infinite. Besides, ten or a hundred times infinity is a notion without meaning, as is also that of a fixed infinite number. To say that there exists an infinite number of atoms in the universe is to state an absurdity.

The idea of infinity which we attain by reasoning cannot be applied to a number, as Galileo demonstrated three centuries ago. If we wish to divide something actual into an infinite number of parts, we are merely playing with words and applying to reality what is only an abstraction.

The point is said to give rise to the line of continual motion; bnt notice, that in order to imagine that line you require several abstract notions which correspond to nothing real. In the same way you can imagine an indefinite number of fractions between 0 and 1, and as you are free to bring them as near to 0 as you please; you can imagine a series previously calculated, that is represented by a number in the form of an indefinitely decreasing fraction. Are we to say that the reality corresponds to this product of pure abstract thought? Here is precisely the problem.

From the sensation of extent we rise to the abstract notion of space, but the reality may not correspond to our conception; no more than the colour red or a note in the musical scale corresponds externally to the sensation it produces within us. And what is true of a note. which needs a determinate series of vibrations in order that the next note may be audible to us—a purely artificial continuity—must be equally true of our sensation of space. If the continuity is only apparent for the notes of the scale, why should it be real for the sensation of sight? In neither case do we really apprehend the continuity by our sensations, and our conception of it is truly the result of abstract thought.

Let us then not transfer into the sensible order what belongs to the sphere of the ideal.

Space *in itself* does not then exist; but we cannot deny the possibility of the existence, outside ourselves, of real beings able to constitute its extent. For this real beings are needed, and as they cannot exist in infinite numbers, the extent itself is not infinite.* The fact is, I can add as many units as I please to the finite sum of actual beings; I can then at my pleasure increase the real extent of space; and that is why, by generalizing that notion, I arrive at the idea of infinite space; but as soon as I join to that idea the essentially determinate idea of number, I wrongly couple together notions which, united, can only produce an unreal and absurd result.

Through the senses of sight and touch I acquire the notion of multiple beings outside myself; these beings, or causes rather, without prejudging anything as to their essential nature, exercise on my body, which is quantitive like them, a series of actions which I recognize in the form of sensations; the various parts of my body which experience those actions inform me of their quantitive value; the whole mystery of "extent" is involved in this.

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* It is curious to find that this conclusion had already been expressed, in 1854, by one of the founders of the new Geometries, B. Riemann: "Observation teaches us with great certainty that actual space is not infinite, but unlimited."

Let us express this more precisely by an example. Let us suppose a hundred external causes affecting my body at a hundred points; it is evident that, quantitively, my body will be more affected than ten causes working under the same conditions. I conclude that the body external to myself that is influencing me in the first case is more extended than that working on me in the second.

What constitutes the extent is, then, the multiplicity of the external causes working on a multiplicity of parts, simultaneously transmitting an impression, all warning that consciousness within us which controls, which judges, and which we call one *soul*.

And here, let us notice in passing, that the word *soul* does not assume anything; that the consciousness that we call by this name exists there can be no doubt; to deny it is to deny evidence. Of what nature it is, is another question, which we shall enter on at the right moment. Is it simple or complex, extended or unextended? These points we shall have to define.

The preceding reasonings however do not give us any idea of the extent of being that exists outside ourselves.

Kant said that "space is but a subjective, *a priori* conception, without which impressions could not be grasped; it is the mould of phenomena, that is, of appearances; in itself it is nothing." *

In writing thus, the philosopher of Königsberg has allowed too much to subjectivism, or rather has defined nothing at all. He has confused space and extent. That space is nothing outside material bodies is evident; but the same is not true as to extent; and to say that the latter is an *a priori* mould of our sensible experiences is not to define it objectively.

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* Kant; "Gothétigue transcendantale." Sect. 1.

Let us take three particles of matter, A, B, C. Let us make no hypothesis, which would pre-suppose extent, as to their size. Let us suppose them to be in such relation to each other that A acts upon B without acting upon C, and that B acts upon A and C simultaneously. That kind of simultaneous relation sufficiently defines extent in itself.

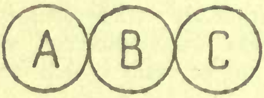

Fig. 2

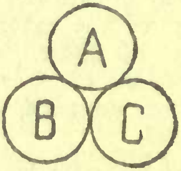

Fig. 3

But if A can only act upon B, without acting directly upon C, I say that B separates them (fig. 2).

In what manner can these three particles act upon each? That I do not know and shall never know. We touch at this point the "problem of action," and no philosopher has been able to sound its depths. Yet that action is not inconceivable; what is sensation but the action of an external cause on my body, an action transmitted by the particles of my body, but which I perceive in the form of a state of consciousness, a modification of *myself*?

Whenever one cause acts upon another to modify it, to produce an effect, I say that the two substances are in *contact*. That contact gives the notion of *place*.

Let us now supppose that A, B, C, can act simultaneously upon each other; then I shall have the idea of a different spatial form, and shall say that the three substances have changed their position (fig. 3). But if A, which already acts upon B, can can act upon C without still acting upon B, I shall have the idea of motion.

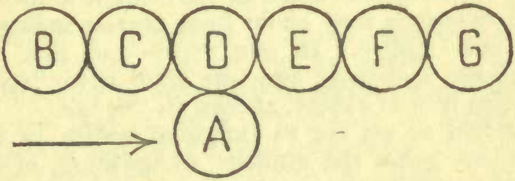

Fig. 4

I can even conceive a series of particles B, C, D, E, F, G, and a seventh particle (A) acting successively on the six, and I shall have the idea of continuous and persistent motion (fig. 4).

The figures I give are merely to aid us to understand the principle. To have an idea of extent and motion it is enough to remember the mechanism.

Outside of me, what is the intimate nature of the phenomenon, the cause of what appears? I do not know; but the sensation is produced by external objects changing their relations of action and causality, and that is enough for me.

We shall see further on that extent is not necessarily required for the ultimate material particle;* what constitutes the essence of extent is the multiplicity and the complexity of the relations involved.

Our notion of extent or rather of space (which is a generalization of the notion of extent) comes then directly from experience; we do not know why the particles have such relations with each other; so far as we can search into the problem, those relations do not appear to be necessary. But if they are not, they depend upon a will which has determined their conditions. Why has God willed that they should be thus? We do not know, but it is quite obvious that He could have arranged them otherwise.*

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* See Chap. IX, p. 104.

And since we are undoubtedly far from ever suspecting all the laws that govern these relations between the various material particles, it follows that our abstractions may be far from corresponding with the whole reality. In one word—and this might have been said long ago—we shall never have an adequate idea of extent, at least in this life.

Rivetted as we are to extended bodies of which we cannot guess the ultimate composition, of which we only perceive the mechanism from a very narrow angle, how could we claim to grasp all the details of molecular phenomena, all the innumerable actions that take place within and without ourselves?

We only perceive the results, without being able to analyse the manner in which the complex mechanism works.

Such considerations will help us to realize better the experimental character of Geometry, that science which the savants of old declared to be necessary, but which in reality must reflect our general notion of space, which is itself founded on a mass of data very limited and consequently insufficient.

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* Cf. Balmès: *Phil. Fond.* Book III.

CHAPTER V

THE UNCERTAINTIES OF OUR GEOMETRY

GEOMETRY is the science of Space in general, that is to say, a science founded on the notion of extent, generalized by us according to sensible data; whence it follows that if these are unable to fathom the mysteries of extent, we shall remain for ever unable to build Geometry on a solid basis. That is exactly what we find to be the case. The notion of extent, as we conceive it, suffices for our present needs, and so does the Geometry that we deduce from it.

If we were asked to justify such a science by showing that it has its roots in the very essence of things, we should be completely at a loss to do so.

How do we learn Geometry? By means of rigorously connected propositions, which by their indisputable logic still supply the best mental discipline. But if these propositions form so many links of a perfect chain, we must conclude that there exists a first link. With what are we to connect it?

First of all, with axioms, that is to say with obvious truths which require no demonstration, such as: "The whole is greater than the part;" "Two quantities equal to a third are equal to each other;" but in the main we simply apply pure arithmetical axioms to the idea of extent which we have imagined. The proof of this lies in the greater complexity of the geometrical axiom.*

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* There is a wide difference between the arithmetical axiom and the geometrical. While the first appears to us necessary, because it depends on the necessary notion of quantity, the second depends, partly at least, on sensible data. The sequel of this chapter will make this clearer.

"The straight line is the shortest way from one point to another." I am required to assent to that proposition; my experience cannot invalidate it; it seems clear enough and perfectly correct, but I should like to see it demonstrated.

It is an axiom, I shall be told. May be; but if I questioned it you would be extremely puzzled. The axiom, you would reply, is derived from the notions of a straight line. Define a straight line then, since what you have just stated is only a property of it. As soon as you try to give what a metaphysician calls a proper definition, you will find yourself brought to a standstill. It will be useless to introduce the motion of the point, the direction, the shortest distance—you will never succeed in making the idea of "straight" any clearer.

Thus at the very beginning you are stopped by an insurmountable obstacle! a bad beginning, you will confess, for a science that claims to be exact.

Let us proceed further: one of the first propositions presented to us by geometricians will concern parallel straight lines which prolonged ever so far will never meet. and we find this placed by Euclid at the very foundation of all Geometry.*

This is how we express it to-day: "From any point taken from a straight line (1) it is possible to trace a parallel to that line; (2) it is impossible to trace more than one."

Suppose a straight line A B; I take a point C out of this line, above it; Euclid will demonstrate that it is possible to trace from this exterior point another straight line C D, parallel to the first. All we need do is to draw a perpendicular line from C to the first parallel, and other perpendicular C D; C D, we can demonstrate, will never meet A B, and is therefore parallel to it.

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* To Euclid, a famous Greek geometrician who lived about B.C. 320, belongs the honour of having established in a book, still a standard authority in teaching, the principles of the accepted Geometry. According to M. Barbarin (*La Géométrie non Euclidienne*, p. 7) Euclid never attributed more than a hypothetical value to his postulate, and it is not impossible that he even examined, momentarily, the contrary hypothesis.

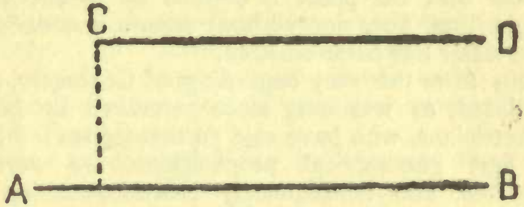

Fig. 5,

Let us now pass to the second part of the postulate: "From that point C I can only draw one parallel, *i.e.* C D will be the only line drawn through C that cannot meet the line A B."

Here it was useless for Euclid to seek for a demonstration; it has remained undiscoverable, and clever mathematicians have since demonstrated that it never will be discovered. And Euclid, nevertheless, did not hesitate to build up the whole of Geometry upon that undemonstrated postulate; he asked us simply to accept it.* This is why the geometricians have given this postulate the name of *Euclid's Postulate* [*postulare*, to ask or demand].

I have said that no one would ever demonstrate it, but that is not quite exact; some mathematicians could prove it, but only by the help of another indemonstrable theorem. And if we are to admit a postulate, the old one is quite as good as the new.

But let us note that we are now dealing with plane

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* This is how Euclid presents the proposition: "If two straight lines, situated in the same plane, form with a secant, and on the same side of this, interior angles the sum of which is smaller than two right angles, those straight lines, if prolonged sufficiently far will meet on that side."

Geometry; all figures, triangles, parallelograms, polygons of every shape, are supposed to be plane surfaces. It would be interesting to define the *plane*, which no one has ever seen, which is a pure abstraction, and of which we have but a vague idea. I know that the plane is defined by means of the straight line, but, not without reason, the definition of the latter has been omitted.

Thus from the very beginning of Geometry, all is postulated, as was long since perceived by famous geometricians, who have said to themselves: "Since the first geomatrical propositions are veritable postulates, and consequently indemonstrable, they afford it may be very fragile bases which do not rest on reality; it would be of great interest to try to do without them, to substitute for them different or opposite postulates, and to see the ultimate results of the intrusion of these new-comers which, after all, can be neither better nor worse than the former."

And this programme they have realized in every point, and they have succeeded in building up a geomatrical system as harmonious as the old Euclidian Geometry, a system in which the ancient axioms are replaced by others, obviously indemonstrable, but which can be disproved no more than Euclid's. The last result of these attempts has been to give us a system of geometry rigorously linked together, different from the former, inconsistent with Euclid's propositions, and yet not enabling us to accuse them of being illogical.

Mathematics, it has often been said, are like a wonderfully constructed engine, but by setting it going one only gathers at the end what one has put into it at the beginning. The conclusion is worth as much as the premisses, and it is this which explains the success of the new geometricians.

If our Euclidian Geometry in its conclusions seems very near reality, it does not follow that it is rigorously exact; and if Euclid's postulate is founded on a common notion of extent, on a notion suggested by our senses, our habits, and a long education, it is very probable that by applying to it a series of mathematical reasonings we should arrive at conclusions which do not invalidate every-day human experience.

The idea of a non-Euclidian Geometry may very probably be attributed to the celebrated mathematician Gauss,* who lived early in the nineteenth century; but its principles have only been settled since his time.†

Father Saccheri of Milan, in 1833, was the first to enquire what would happen if, abandoning Euclid's postulate, one were to admit that "from one point it is possible to draw more than one parallel to a straight line." He already foresaw the rise of three distinct Geometries; but all these enquiries took definite form a little later (1840), as a result of the labours of Lobatschewsky, a learned Russian geometrician at the University of Kazan, and of the Hungarian John Bolyai.

"Let us suppose," said Lobatschewsky, "that from a given point we can draw more than one parallel to a straight line, and this hypothesis is quite as legitimate as Euclid's—what will happen?" And the mathematician proves that one arrives logically at propositions which contradict those of the ancient Geometry; thus in his system the sum of the angles of a triangle are *less* than two right angles.‡

A little later (1854) Riemann, taking a precisely opposite position to Lobatschewsky's, advanced the theory that "from any point it is impossible to draw *any* parallel to a straight line," and he founded a third, extremely curious Geometry, as logical as the two earlier systems, according to which the sum of the angles of a triangle are *greater* than two right angles.*

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* Professor of Astronomy at Göttigen (1777-1855).

† For further details consult *Engel und Stäckel, Theorie Parallelinien von Euklid bis auf Gauss* (Leipzig, Trubner, 1895); and R. Bonola, La Geometria non euclidea (Bologna 1906).

‡ N. I. Lobatschewsky: *Pangéometrie* (1855), which contains the whole statement of his theories.

By what sort of principles were doctrines apparently so subversive supported ? I will try to give at least an idea of them.

We have seen how, throughout Geometry, one comes back, at the base of everything, to the two ideas of the straight line and the plane, neither of which we can define. Well then, let us imagine beings which exist entirely in a plane surface, having consequently only length and breadth without any thickness, or a thickness extremely minute, and atomic in character. Let us place these beings on a curved surface, for instance on a sphere of so great a radius as to make the curve insensible. There is nothing absurd about this hypothesis ; if the Earth, small as it is, were polished absolutely smooth, we could use it as a surface on which to deposit our strange subjects.

These beings, practically without height but possessing two dimensions, would be able, in their coming and going, to establish a very peculiar Geometry.

With regard to themselves they will work out a plane Geometry, *i.e.* of two dimensions. But when they work in their study or in the field they will arrive at different conclusions.

However unwilling we may be to accept this conclusion, it is easy to prove it.

If it is a question of drawing straight lines in a small space, our inhabitants will never suspect the slight curve of the plan on which they move. We ourselves, on our terrestrial sphere with its great radius, have no material means delicate enough to show the real sphericity of the surface of the liquid in a basin.

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* B. Riemann, one of the successors of Gauss at Göttigen. Cf. his Memorandum *Sur les Hypothèses qui servent de fondement à la Géométrie.*

When we draw triangles on such a surface, describing arcs of great intersecting circles, nothing warns us that we have to do with spherical triangles.

Our hypothetical beings of two dimensions are in a position to establish a plane Geometry such as Euclid's. But suppose they have an inclination for travels, explorations, and discoveries, they are at once plunged in the worst uncertainities.

If one of them takes it into his head to go straight forward, turning neither to right nor left, he will finally make the whole circle of the sphere he inhabits, with no suspicion that he has done so, and will return to his point of departure. If that point has been marked, he will conclude, not unreasonably, that every straight line is finite, and will turn this into an axiom.

Let us now suppose that the great circle thus travelled over to be the earth's equator; if the idea came to these beings to conceive perpendicular lines at long intervals upon this imaginary circle, analogous to our meridians of longtitude, nothing will warn them that these are not strictly parallel. They will regard them as such, both logically and experimentally; but if one of these beings endeavoured to inform himself as to the nature of these pseudo-parallels by travelling over different meridians, the result obtained would upset all the notions which they had so laboriously acquired.

By pursuing their travels in a direction that seems invariable, they will end by running into each other at the poles, and from this they will conclude that "from a given point one can draw many perpendicular lines in a single plane to the same straight line"—a principle contrary to the Geometry that we profess, Now who can assure us that we are not, to a certain point, like these hypothetical creatures who are obliged by their situation to construct a Geometry different from ours?

Of what nature is the space we occupy? We know nothing about it. Are we certain that two lines which appear to be parallel will not finally meet or diverge? The question, however merely speculative it may be, would lead us, if we could find the answer, to conclusions of great interest to the geometrician and the philosopher.

Do our parallels meet? If so, the sum of the angles of a triangle, the vertices of which are occupied by three stars immensely distant, would be greater than two right angles, and it would become easy to demonstrate that the whole extent of space is a finite quantity. If the parallels in question diverged we should arrive, on the contrary, at exactly opposite conclusions.

We see that the doctrine of different spaces which mathematicians have termed *spherical*, *eliptical*, or *hyperbolical*, in short the notion of a *curve-space*, touches the very foundations of our sensible knowledge.

The Euclidian Geometry which we use, is in fact only a particular aspect of a more general Geometry, which is studied to-day under the name of Metageometry.*

Nevertheless it is worth noticing that in our

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* With regard to all these studies the following works may be profitably consulted: P Mansion: *Premiers Principes de Métagéometrie;* H. Laurent: *Sur les Principes fondamenteaux de la Théorie des Nombres et de la Géometrie* (Coll. *Scientia.* Gauthier-Villars, Paris); P. Barberin: *La Géométrie non Euclidienne* (Coll. *Scientia.* Gauthier-Villars, Paris, 2nd ed. 1907); E. Youffret: *Melanges de Géométrie à quartre dimensions*, and the same author's *Traité Elementaire de Géométrie à quatre dimensions* (Gauthier-Villars, 1906); G. Lechalas: *Étude sur l'Espace et le Temps* (Alcan, Paris, 2nd ed. 1910); G. Bruce Halsted: *Rational Geometry* (Wiley, New York, 1904.)

Geometry, as well as in that of eliptical or hyperbolical space, the conclusions reached are identical for extremely small surfaces; they begin to differ only when very large figures are concerned, and we have no experimental means of knowing the kind of space we have to deal with.

More than this; just as our mechanics, as we have seen, are found deficient when we try to apply them to the ultimate material particle, so a great number of facts go to prove that our Geometry loses all contact with reality when we penetrate into the domain of the infinitely little, which is only indirectly accessible to our senses. Such thoughts were developed by the scientist Riemann when he wrote this apparently disconcerting sentence: "When it is a question of extending empirical determination to the immeasurably great or the immeasurably small, the metrical proportions become more and more inexact as soon as one oversteps the limits of observation.* In fact, Lobatschewsky himself tried to control his hypothesis by experience in relying on observations concerning the annual parallax of the stars. His conclusion was that among all the rectilinear triangles, however great, which men will ever be able to measure, there will not be one in which the sum of the angles varies to any appreciable degree, or so as to cause any serious error in observations.

If our space is not Euclidian, but elliptical, we can, I suppose, demonstrate that to any given point, our Sun for instance, should correspond an opposite or polar point, the locus of which would be in a surface as far distant as possible, since in such a space a plane could not be infinite; but no observations, so far, permit us to conclude that such a material point exists; if it did, its distance would overpass the limits of the known universe.

* Riemann's Works, translated by Lauget.

In this direction, then, we have nothing to expect from observation; but we may be more fortunate when we turn to what Riemann calls the "immeasurably little"; not that we can hope by the help of our instruments and direct observation to reach the ultimate particle of matter; but it may be that the deductions drawn from the study of molecular forces will some day, and before long, put us in the way to solve this acute problem.

CHAPTER VI

A STRANGE WORLD

"THERE exists a whole domain of mathematical thought which one may call the fairyland of Geometry. In that domain the mathematician amuses himself to the extent of letting the profane suppose that his teaching is less that of a series of vigorously interdependent demonstrations than of the capricious flight of a delirious fancy."*

Thus expressed himself the great Newcomb, mathematician and astronomer, many years ago, in a celebrated address which, I confess, has been to me almost a revelation.

I was not unfamiliar with the mathematicians' conquests in the field of Metageometry, but the results remained merely speculative to my mind, and the theorems of the Geometry of hyperbolic space seemed to me to matter no more than the discovery of some new property in the prime numbers. But to-day, after many years of constant meditation, I understand Newcomb's thought; the fairyland which he opened to me has shown me that Philosophy should draw from that new domain much that can nourish its adepts. Often, when surveying these new fields of science, I have promised myself that I would give to the public an account of the

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*S. Newcomb: *Philosophy and Hyperspace.* Address to the American Mathematical Association. French translation by Th. Moreux (1899).

landscapes of which I had a glimpse; a task, I acknowledge, bristling with difficulties.

The philosophy of space, such as we can conceive it after our recent explorations, could very well be represented by an island lost in the Pacific; a land difficult of access, not only because it is so remote, but chiefly because of the insuperable belt of rugged rocks that surrounds it.

"No one enters here but a geometrician," wrote Plato above his door. No one penetrates into this island who is not familiar with the higher Analysis, and who has not explored the most secret arcana of Mathematics. And to make any progress in that mysterious land we must lay aside entirely the notions we have acquired by experience.

Those who have performed these marvellous excursions cannot claim to entice all their readers thither, but, like the ancient bards, they can at least try to relate their travels in this almost unexplored kingdom.

All our conceptions of Space are founded on the acquired, if not innate, notion of three dimensions. I cannot imagine a material being that could present itself to my senses except as occupying a certain amount of space, and possessing length, breadth, and bulk. If I told you that beings having four dimensions can exist, you would reply that you cannot form any image of such creatures.

That we cannot "imagine" such—in other words, that such beings cannot present themselves to our sensible faculties under an accustomed form, is very obvious; but it is a totally different question whether we cannot "conceive" them, *i.e.*, establish certain conditions of their existence, or some of their properties, from the point of view of Space.

We have seen that, fundamentally, the objective "extent" comes back to the relations between distinct material objects. Their mutual relation explains all, and there is no case, however exceptional, in which we need have recourse to any other assumption.

Since by virtue of our faculty of abstraction, or generalization, all mankind are bound to make the effort to conceive a space greater than that which we inhabit, there is no one who cannot imagine a simpler sphere, in which only two dimensions would exist.

Let us then resume, with slight modification, the hypothesis of the last chapter. Let us then imagine beings of only two dimensions, not this time moving in a curved space, but on a horizontal surface, like the plane as we conceive it in Euclid's Geometry. To make this supposition easier, and to enable you to translate it into sensible data, I will grant that these beings have an extremely slight bulk, say that of an electron, or even of an atom, in which case, if their senses are not more refined than ours, they will never be able to conceive the necessity of height—or bulk—*i.e.*, of the third dimension which we, conditioned as we are, could not discard without going outside the domain of reality accessible to our senses.

We will now picture these beings at work to construct the idea of a universe subject to the laws of extension, a Geometry founded on experience, and rational Mechanics that can account for the phenomena ascertained.

It is obvious that in such a Universe each material object can only be surveyed by following its outlines; the surfaces must always escape direct observation, since they cannot be examined from above, or by a general view; since that would imply that these supposed beings could raise themselves, and therefore that they possessed the third dimension.

The inhabitants of this hypothetical world will no more be able to know the interior of their "plane-objects," and to analyse them, than we can penetrate into the interior of our bodies (which possess three dimensions), except by dissection. They will have, nevertheless, a clear notion of changes of direction, and consequently will before long acquire the notion of perpendicular straight lines and angles, which seems to be all that is needed to construct a Geometry analogous to ours.

Yet the acquisition of such a Geometry would undoubtedly imply the idea of the third dimension; in any case its absence would form an almost insuperable difficulty to our "surface-beings."

If we attempt to demonstrate the theorems that relate to equal triangles, we begin by laying down as an axiom that "two figures are equal when they can be exactly superimposed on each other." Whence it follows that if two figures are symmetrical we can prove their equality only by laying them one upon another; which implicitly supposes that, to attain our purpose, a surface can be turned over, and that this operation in no way alters the figure. And yet we use this method of reasoning every moment!

If you wish, for instance, to prove the equality of the surfaces of two pages of the book you are now reading, you will lay one on the other to verify their co-incidence; you could certainly detach them and let one slide on the other, but you could not do this in the case of such symmetrical figures as any two triangles the sides of which are reciprocally equal. Examine those I here give you, cut out two identical pieces of paper and lay them on your table.

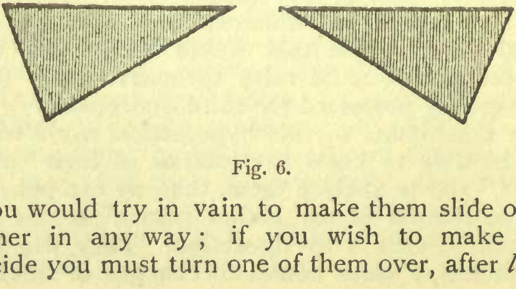

Fig. 6.

You would try in vain to make them slide one on another in any way; if you wish to make them coincide you must turn one of them over, after *lifting* it from the table, in short after having availed yourself of the fact that you have at your disposal a third dimension.

But our supposed surface-beings are not so well provided; for them a plane surface such as a trapdoor could not turn on its hinges; the method of superimposition, so generally used and so eminently serviceable in our geometry, is totally unknown to them, and by this it is easy to see the difficulty they must experience, from the very outset, in creating a rigorous and easy geometry.

And yet they lack but a single notion to make all clear, and if the more intelligent of them, without forming an image of the third dimension, succeed in conceiving the idea and introducing it in their formulæ, a simplification, at once artistic and convenient, will be the result.

To conclude from this the possibility of the existence of a world of three dimensions will be but one step; yet if such a world exists it will be for ever impenetrable to their senses.

Suppose that such a world continually influences them: they will appreciate its effect, but their sensibility with regard to it will remain unchanged, and it will appeal to their mind only through the medium of organs adapted to plane surfaces; consequently, the existence of such a world will be known to them without their being able to infer that it is localized in space.

So substances may exist in the Universe which influence us and our body, and which are not localized in our space.

That is an extremely interesting statement from the standpoint of supernatural philosophy. There is nothing absurd in itself in admitting the existence of things we do not see, which constantly influence us, of which we perceive the effects without being able to penetrate into their essential nature.

We think that we inhabit a world of three dimensions, but nothing assures us that there is not a fourth, and if such exists we can most logically conceive that some force may influence us through its means; we shall, in that case, feel it, but we shall never see it. Do facts allow us to think this?

It may be so, and we shall shortly examine them; but from this very moment we can say that we feel within us unceasingly acting in every part of our body, a force of which we are conscious, which we call the *soul*, and which is real as this paper along which my pen glides. I am conscious of my soul; more exactly, I feel the varying influences of this entity, which I do not see; it is the first of all realities; it exists for me above all external phenomena, since in order to ascertain their reality I must have recourse to the principle of cause and effect; and without claiming to affirm that my soul is situated in the fourth dimension of space, I maintain that, if such was its relation to my body, I should easily comprehend what my bodily eyes could in this life never see, any more than they could see, in a natural manner, God or another spirit.

And I conceive very well that if by a miracle certain saints could in a rapture see God or behold pure spirits, as St. Paul tells us, it is no less easy to understand how, when the ecstasy was past, they could not tell us what they had seen, because their account of it would have no meaning for us, no sensible image could convey their thought, any more than our suppositious surface-beings could "imagine" a third dimension, or we ourselves "imagine" a fourth.*

But let us continue our excursion in our surface-world; other discoveries await us. We supposed a race of beings who come and go on a horizontal plane; it is not absurd to suppose that they are held secure upon it by a vertical force similar to gravitation and termed gravity when applied to the Earth. But that force, let us notice, acts by hypothesis, according to a line perpendicular to their Space, that is, in a third dimension: the effect of it upon them must be in appearance absolutely *nil*, since otherwise they would have a sensible notion of this third dimension—which would contradict the hypothesis.

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* The word "imagine" is always used in its strict sense, as on p. 60.

Yet such a force may cause visible effects in their world. Have we not examples of this in our own present condition? Is there not a whole series of radiations, such as those of electricity, which our senses perceive, not directly, but only by their indirect effects?

It is then easy to conceive an analogous mechanism for our plane-world, and of this description would be the results of gravity, a force residing in the third dimension of Space, *i.e.* beyond the limits of the known world.

Let us suppose with Mr. Hinton that we pour a certain quantity of liquid upon this strange world; this liquid will tend to diffuse itself everywhere on the surface, *i.e.* since its bulk must absolutely be either non-existent or atomic in bulk, the particles of the substance will tend to occupy the whole space within their reach.*

This singular phenomenon, the cause of which is quite beyond our beings of two dimensions, they will express by a law of which they know neither the nature nor the origin. They simply lack the notion, unimaginable to them, of that third dimension in which the law of gravity operates. And if a clever mathematician succeeds in conceiving and formulating a plausible explanation of the fact, I would wager anything that he would be treated as a dreamer.

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* C. H. Hinton: Scientific Romances: A new Era of Thought. (London: Swan Sonnenschein.) Compare also *Flatland*, a Romance of many Dimensions (Seeley, London, 1886.) An exceedingly curious romance, the scene of which is laid in a world inconceivably minute.

The case is chimerical. Perhaps so ; in any case the analogy explains marvellously a phenomenon which is daily taking place in our Universe. Gases with us, like liquid on a world of plane surface, tend, as is well known, to diffuse themselves, to spread gradually in all directions, and the phenomenon though perfectly familiar to us is quite inexplicable.

But suppose a fourth dimension, and all difficulty vanishes. It is quite possible that the ultimate particles are endowed, though unknown to us, with that dimension which escapes our senses.

In solids, as in liquids, the cohesion is too strong to allow them to diffuse themselves ; but with gases this would not be the case. In them the force of gravitation, acting outside our Space, would tend to diminish their fourth dimension, and would materially increase their density. And I should add that we have strong reasons to believe that it is so. *

We see that the examination of the conditions that would obtain in a world of two dimensions helps us towards the explanation, hitherto unsuspected, of certain phenomena daily observed in our Universe.

Let us not stop here, but pursue our analysis.

When we study our bodies, endowed with three dimensions, all we do is to examine them from outside, without being able to penetrate into them. Every material mass offers to our examination only its surface ; from the three aspects of a cube we are able to infer the existence of the three dimensions.

By analogy, the solids will be manifest to the senses of a two-dimensional being only in the shape of lines, since he is unable, properly speaking, to explore a surface, and as a material plane forms an obstacle to *our* progress, so to him progress will be impossible whenever he encounters the limit of a plane—that is, a line.[*]

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* See the reasons given in Chapter viii of this volume.

If then we confine him within a circle, not only will he be unable to get out, unless we make an opening by cutting the circumference, but he will not even imagine any way by which he could get out. A being of three dimensions, like ourselves, would think it childish to jump or stride over that artificial barrier; he would escape from the plane by means of the third dimension—an expedient unsuspected in our plane-surface world—and for him this would be a matter of course.

Do we not reason in the same way when, enclosed within four walls, ceiling and floor, we look for an opening by which to pass out? Confined as we are in a space of three dimensions it never enters our minds to leave a closed room by other means than the door, or window, or some other opening. But if a fourth dimension were granted us, with the power of moving in it, we should get out of a prison as easily as a child jumps over a line traced on the ground.

For a being so constituted, the sight of a lion confined in its cage, of a bird in an aviary, of a man in a prison cell, would be laughable to the last degree. Nevertheless, if so privileged a creature beholds *us*, we are certain beforehand that such a being is sheltered from our indiscreet gaze, and remains invisible to our senses, though able to influence them.

But we will not anticipate the mysterious properties of the Hyperspace which we shall shortly study; let us return to our plane-surface-beings.

Let us suppose them plunged in a fluid similar to our atmosphere. If this latter is plane—*i.e.* of the bulk of an atom, it will exercise on bodies the effects of attraction and compression which will be transmitted in two directions of the plane ; but if we suppose it to be of greater bulk, the pressure will be transmitted, as with us, in all three directions, according to Pascal's principle, and no explanation would ever satisfy the mind of a scientist who had no conception of the third direction.

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[*] The figure limiting a space of any number of dimensions is expressed by the mass or the surface possessing the same number of dimensions, *minus* one. Thus a space of 4 dimensions is limited by a mass of 3; this latter by a surface of 2 dimensions, and so on.

The impartial study under which plane-surface-dwellers would be compelled to move about makes it obvious that the properties of Space are not absolute at all, but merely reflect possible relations.

Since these relations are merely contingent, we can imagine others, to which all natural bodies, including the human body, might be subjected. The problem, from whatever side we consider it, leads to one only solution that is always the same.

Our conception of the Universe and of the relations existing between the substances which it contains, are therefore imposed upon us beforehand, *i.e. conditioned* to our present state ; we must not forget that all our conclusions with regard to our Space only concern, as has been said, "material possibilities," and it is also probable that they do not embrace the whole external reality, but only that part of it with which we are accustomed to deal.

CHAPTER VII

HYPERSPACE

THE preceding chapters will help us to make yet another step forward, enabling us to rise to the conception of a Space of four, or even more, dimensions. It is obvious from the first that such a notion cannot be definitely described.

We constantly make use of images in order to study the balance-sheet of our knowledge. Aristotle said long ago: "There is nothing in the understanding which has not been in the senses," but this proposition, which was admitted later by the Schoolmen, requires explanation. This has been supplied by the Angelic Doctor, and nothing will ever overthrow his reasoning.

St. Thomas calls the phenomena of imagination, consequently the visible data, *phantasmata*; and it is precisely upon these data that our understanding, an intellectual faculty, exercises itself.*

By what mechanism does our soul arrive at the *phantasmata*? We will leave to the philosopher the discussion of that difficult question. In the meantime it matters little whether we can answer it; it will be enough to say, with St. Thomas, that during its union with the body the soul exercises its power of comprehension only *per conversionem ad phantasmata*. "In other words," says Balmès, "the image which serves as material for the formation of the idea, which illumines and animates it, precedes and accompanies the intellectual act.*

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* *Summa Theol.* Part I. Q. 79, a. 4, 5.

One must, then, not confuse the image and the idea. Often the abstract idea is as incapable of sensible images as it is of words, and yet the idea exists. The statement, *e.g.* of a relation or similarity is completely outside the image, even verbally so; it is characteristic of the intelligence which conceives such similarity and relation.

Thus to *imagine* and to *conceive* are two distinct mental conditions, whatever may be the nature of mind or soul—a question which we shall examine further on—and these two states cannot be blended together because they have no point in common; neither can be drawn nearer to the other, it is not a question of degree; the two states have no common measure; they are, as the geometrical phrase runs and in this sense only, incommensurable.

As we enter upon the study of Hyperspace, do not think that I shall try to help you to *imagine* a space of more than three dimensions; that would be contrary to the thesis we have just demonstrated; we *imagine* by the means of sensible data and we can only construct an image by the help of sensation.

A sensation *imaginary in itself* does not exist; otherwise we should be able to give a blind man the idea of colour. Even in the phenomena of memory or hallucination what is imaginary is not the sensation, but the external cause which is unexistent at the moment when these phenomena take place.

To *imagine* a space of four dimensions would imply that we have seen or felt objects of this kind and that we have gone outside our own actual Space.

But if the mathematician cannot *imagine* Hyperspace any better than other people, he can at least study its conditions, submit them to analysis, and by the faculty of abstraction extract, so to speak,

* *Phil. Fond.* Book IV, Ch. vi. 23.

their essence. He can, for example, examine the relations between objects in a sphere of two dimensions—he can easily imagine such a sphere—and then proceed to the study of bodies situated in our own three-dimensional space; and it is precisely thus that what we call Analytical Geometry has been established.

In this abstract science, which is however to a certain point the science of the Real, the relations of geometrical figures become complicated, in a certain unalterable manner, as we pass from the study of the plane to that of bulk, *i.e.* from the space of two dimensions to the higher three dimensional space; who can logically hinder us from going still higher and introducing, at the right place, in our formulæ whatever is necessary to represent a space immediately above the preceding one, *i.e.* a space of four dimensions—and so on?

That is a matter of Algebra, you will say, and I do not deny it, but notice carefully that Algebra is not exactly a science, one may compare it to those machines which perform mechanically all arithmetical calculations, even the most complicated. If the axles in the machine are not bent, if the cogwheels possess their complete dentition, and if you thoroughly understand the mechanism, I defy you to arrive at a wrong result.

This is just what happens in the study of the different Spaces in Analytical Geometry, where the formulæ are linked together mechanically without the possibility of error. If we arrive experimentally at exact formulæ for the third dimension we shall proceed logically to the fourth, and so on without ever reaching a limit.

At this point my reader may well stop me and object. I admit these results, but affirm that they will always be speculative and correspond to nothing real. You could prove to me that beyond the Milky Way an invisible universe may exist, a thousand million times greater than ours, it does not follow that I must believe in its existence. In the same way your space of four dimensions remains a mere hypothesis.

To which I answer that, for the moment, I agree with you. So all I wish at present is to demonstrate the *possibility* of the *fact.* That is the first step, and the task seems to me arduous enough to hinder my undertaking anything else at the same time.

From this point we must lay aside every sensible intuition and abstract ourselves so far as is possible from objective images. Let us begin by fixing the position of a point on a plane surface, that is, in a space of two dimensions. Here is a minute grain of sand placed on the rectangular table at which I am writing. The place it occupies—I suppose the grain to be reduced to a single point—can easily be determined by measurement. Two measurements will show me that it is situated at a distance of 20 centimètres from one edge of the table, and 30 cm. from the other. I have been careful to extend my measurements to the very edges on both the long and broad side of my table.

Its position then is clearly indicated by the two numbers 20 and 30. These two numbers are dignified by geometricians with the high-sounding name of *co-ordinates* of the point (fig. 7).

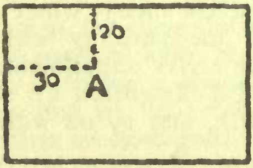

Fig. 7.

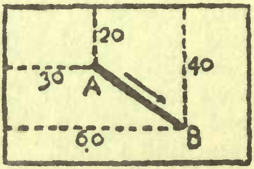

Fig. 8.

I can now remove the grain of sand; I have an infallible means of replacing it. I have only to measure the co-ordinates to find the former position.

Suppose now that my grain of sand rolls in any direction in a straight line, and that it stops at B (fig. 8). It will have acquired other co-ordinates, *i.e.* its final position will be expressed once more by two numbers which I estimate in centimètres, say 60 and 40; now during its journey it has crossed intermediate points which I do not know; but what I easily conceive is that to all these successive points correspond two series of numbers, that for every position there can only be *two* numbers, *i.e.* two co-ordinates. If I do not take their bearings, a geometrician will have no difficulty in calculating them by the help of the numbers corresponding to the extremities of the co-ordinates; he could proceed in a similar way if my grain of sand had described, instead of a straight line, any curve, the arc of a circle, a parabola, a hyperbola, etc.

Those two numbers, which are necessary to fix at each moment the position of a point moving over a plane surface, vary by a regular succession, they are then termed the *variables* of the moving point, and you see that, whatever may be its position, our point can only be represented on our plane surface by two conjoined variables.

In our supposed surface-world, the surface-inhabitants would be able to acquire these simple notions of Analytical Geometry in two dimensions, but they could never *imagine* that the point in question could depend on three variables, that is on three numbers instead of two and yet they could quite well *conceive* the mathematical possibility.

Equations with two variables in fact exist in Algebra, independently of any reference to space; and it is precisely these equations which geometricians make use of to solve all questions relating to the co-ordinates of a point in a plane surface; but you will easily understand that it gives them no more trouble to introduce a third variable into their equations, and this often takes place; the third variable being a third number becomes a third co-ordinate if it is a question relating to space.

It happens that for us this third co-ordinate corresponds to something real, which we therefore imagine easily, but which would stay in the domain of the possible only, to a being living on a plane surface. That is why such a being could not *imagine* this third co-ordinate, but could, by means of Algebra, quite clearly *conceive* it.

If any doubt can still linger in the reader's mind, the following considerations may help to clear up these abstract notions.

We have seen that a third variable obviously exists in our Space. We must now demonstrate that.

I am at this moment in my office, a rectangular room ; my table is in the middle of the room and my lamp, which stands on it, throws its light on the paper on which I write these lines. I wish to determine the position of this lamp ; we shall see that this time I need three numbers.

I am obliged to consider that position in reference to the two intersecting walls and to the floor of the room, *i.e.* to three planes.

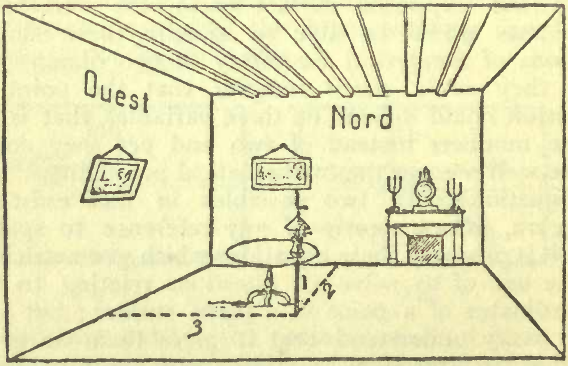

Fig. 9

I find on measuring that my lamp is two mètres distant from the north wall, and three mètres from the west wall of my room; but that is not enough, I must add a third number telling me the height above the floor; I measure, and find it to be one mètre (fig. 9).

The numbers 3, 2, 1, are co-ordinates within the space of the lamp. If I move it, even in the very act of doing so, these numbers will vary constantly, and the series of the three variables will indicate the direction of the movement.

Thus the number of the co-ordinates or variables is always related to the number of the dimensions of the space under consideration, and is rigorously equal to these dimensions.

In a plane space, on a surface-world, we have *two* co-ordinates, *two* dimensions; in our space, *three* co-ordinates, *three* dimensions.

The movements which take place in each space are ruled by definite laws which we cannot change. If I nail my ruler on my table—a plane surface—the other end of it cannot pass out of that plane; it will describe a circle, and the points of that plane curve will be the only ones it will be able to describe; it cannot go out of the space in which it is confined. The equations of its positions will never admit more than two variables.

Now I fasten a string to a peg and suspend a marble by it; the points of the space which the marble will be able to occupy, on the end of the hanging string, will belong to a sphere the radius of which will be exactly represented by the length of the string. But the sphere is contained in a space of three dimensions, and by the help of threeco-ordinates we can mark each point so occupied.

We can say with Newcomb: "This restriction of the dimensions of the space to the number of three can be regarded, in a certain sense, as a physical fact. Our conception of space is based, in its origin, on the possibility of motion, and the threefold possibility of the relative motion can be reduced to a physical fact in the following way:"* and here Newcombe uses the preceding example, slightly modified. Instead of the peg, he imagines a vertical wall, and a rod, one of the ends of which is attached to the wall; the other end, like our string, will describe a sphere. But if we solder that end to another mobile rod, itself attached to another point of the wall, the end A will only be able to move in the wake of a circumference. If we now attach this point A by a third rod to another wall, our point becomes motionless.

Yet it could still move, if we added a fourth dimension. However paradoxical this assertion may appear, it is all the same absolutely correct if we consider it intellectually.

To add a fourth dimension to space is after all only to introduce a fourth variable into our equations —mere play-work for the algebraist.

Do not ask in what direction that fourth dimension is to be found: put in that way the question has no meaning. One might as well ask in what direction a fourth movement is possible in our space. I do not know, and never shall know; but I can conceive that the relations of position between objects connected by three co-ordinates or variables, can be changed by an Almighty Being who has determined the order of those relations by His will, and I can equally well admit that instead of being confined to three quantities they might be more complicated and depend upon four.

Besides, Nature presents us with a great number of phenomena connected with the existence of more than three variables, and this fact will help us immensely to grasp the possibility of what we have just stated.

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* S. Newcomb, *op. cit.*

When we wish to estimate the height of the mercury in a barometer (barometrical pressure) we are usually satisfied with applying to the height indicated, two corrections only; we take account, that is, of the altitude above sea-level, and of the temperature. In this case, the height at a given moment depends upon two independent variables, just like the co-ordinates in the plane.

But if we wish to know the exact pressure we must supply some other data, the chief of which would be the capillarity of the tube and the force of gravitation at the place in question.

There is then a physical value (barometrical pressure) connected with four independent variables, entirely analogous to my four co-ordinates of the space above ours—*i.e.* Hyperspace.

This notion of Hyperspace, therefore, since there is nothing absurd about it in itself, expresses, whether we will or no, the possibility of a fact comprehensible to our understanding.

More than this; we are entitled to submit to mathematical analysis this hypothesis, of which we cannot dispute the legitimacy without denying human logic, and to study it in detail by applying to it the rules which guide us in our geometrical and algebraical processes.

Starting from a fixed, certain principle, if our equations are rigorously deducted we must arrive at conclusions as absolutely exact as those drawn from the study of analytical three-dimensional Geometry.

Once more; it is of little importance, at present, to discuss the objective existence and reality of Hyperspace—that will be the business of the natural philosopher; but the duty of those who probe deeply into Mathematics is, above all, to work out the hypothesis to its ultimate consequences, to clear the ground, and then to say: "If Hyperspace exists, if certain phenomena of our Universe depend on a fourth dimension, it is for those who undertake the study of them as their special mission to tell us what their results will be; we have considered the subject from the theoretical and speculative standpoint, it is for others to get the facts to speak."

To these savants we say again: "Above all, question the infinitely little, dissect the atom, study chemical energy, radiations of every description; dig deep into the problem of material substance as well as that of ether; elucidate the mystery of the vital principle, as well as that of the molecule.

The time is over when one cherished the fond delusion of hoping to reduce all phenomena to Algebra and standard Mechanics; this latter science has not succeeded in penetrating to the basis of things; all its principles go adrift; and while we can, strictly speaking, maintain its laws in the study of the great celestial motions, as to which they still render us more than one service, we have long ago been compelled to throw the science overboard so soon as we overstep the mysterious threshold of molecular Physics. We offer you a new science; see if you can turn it to advantage, and adapt it to the new data, with which your delicate experiments have furnished you.

CHAPTER VIII

SUGGESTIONS

IT is extremely interesting for both the scientist and the philosopher to follow step by step the series of reasonings by which our predecessors arrived at the modern conception of Matter.

From the time that the atom had to be assumed, as the physical base of our elements, it became necessary to inquire into its mode of existence. This ultimate particle, was it solid, liquid, gaseous, or still some other substance? *

It was then that Maxwell, † in his study of the relations, of the ponderable and the imponderable, inferred the existence of an electro-magnetic medium everywhere present; this medium being blended with the perfectly elastic ether, of which Light is only a disturbance.

But as early as 1889 Hertz, of Bonn, suspected more and saw further.

"Electricity," he said at that date, in an address before the Congress at Heidelberg, "touches us in a thousand places where we have not hitherto suspected its presence. In every flame, in every luminous atom, we ascertain its effect. Even in a

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* This question, if so expressed to-day, would have no meaning, since the words solidity, liquefaction, gas, only apply to agglomerations of particles.

† Clerk Maxwell, 1831-79, a celebrated professor of the University of Cambridge.

dark body, if it radiates heat, there are electric reactions. Electricity embraces the whole of Nature. It extends even to ourselves, our eye is an electric organ. If we consider the general results of scientific investigation, we see but one force of which it might be said that its action works at a distance, withont any medium. We should make a grave mistake in saying that; the very law of its activity makes us suspect the mistake. Is not the basis of that activity electric? Then follows the question. What is the nature of Electricity? or, more precisely, what is the essence of the electric and magnetic forces diffused throughout Space?

"And this question involves another. What is the nature of the medium that fills space and which we call ether? What is its structure? Is it mobile or stationary? Is it disseminated to a finite or an infinite extent? One is more convinced every day that this question dominates all others, and that to know what ether is would enable us to understand, not only the essence of the old imponderable fluids, but also the essential nature of matter itself and its fundamental properties, such as gravity and inertia. The old scientists told us that all things come from water and fire; modern Physics do not shrink from asking whether everything does not come from ether. This question marks the supreme aim of our Science."

When one thinks that these words were spoken in 1889, some thirty years before the experiments which should ratify this prophetic outlook, one cannot refrain from a deep sentiment of admiration for the scientist who has thus shown the way to the most fruitful results of Physical Science.

Thus, since the end of the nineteenth century some minds have been able to foresee the consequences of the new light thrown on material phenomena.

"We must state clearly what is at the basis of that theory : Force is the true reality of matter. Matter is but the mode in which Force acts, regulated by the laws of motion. Are the forces that animate atoms immanent in the atoms? We do not know. To explain metaphorically how atoms grouped within the molecule act, we are obliged to attribute to the latter a kind of structure and shape, a system of planes, angles, apexes, and points and to suppose that within these points are interacting forces."*

So the abbé Braig expressed himself at the Congrès International des Catholiques, held at Paris in 1891. And in fact that is the programme which scientists have since tried to realise, but the further we go the more obvious it becomes that we shall never succeed in representing to ourselves, by figures drawn from our own Space, the structure and arrangement of molecules or atoms. It is chiefly by the study of chemical combinations, and by the substitution of elements in our experiments, that we have been led to this all unlooked-for result.

It had long ago been noticed that some atoms possess the property of grouping round themselves an invariably determined number of other atoms ; and from this fact has been inferred the theory of value, which, introduced into organic Chemistry, has enabled that science to develop, in a very short time, in various unexpected directions.

Carbon, for instance, being able to group four atoms of hydrogen is called quadrivalent or *tetravalent*, † while hydrogen is *monovalent*.

But it matters little to the carbon whether its valence be satisfied by such or such atoms ; its

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[*] Dr. Braig : La Matière. Congrès International des Catholiques. Sect. 3, p. 59.

[†] Or *tetratomic*, as it was formerly expressed. See on this subject Lothar Meyer : *Les Théories modernes de la Chimie et leur application à la Mécanique chimique*, No. 93.

appetite is merely quantitative, so to speak. Three atoms of hydrogen and one of chlorine, which is also monovalent, will fulfil the necessary condition.

These formulæ of constitution, which have replaced the old rougher formulæ, constituted a real advance; they permitted one, in fact, to foresee new combinations which have been quickly realised.

But little by little the method has revealed its insufficiency. The systematic schemes did not foresee everything; some groupings remained without any possible explanation. Then we came nearer to the reality; the atoms are under no necessity of grouping themselves according to rule; as a crystal is a figure of space and possesses volume, the same should be true of the molecule. One might have suspected that long ago.

However that may be, the practical results were not long in coming, and Van t'Hoff (1877) began by testing the method on the tetravalent carbon.*

The atom of this substance remains a centre of attraction, the chief of a group, but instead of arranging themselves on the same plane, the monovalent atoms occupy the summits of a quadruple-faced pyramid (tetrahedron).

This theory of tetrahedric carbon formed the starting-point of Stereochemistry, of which the successes are beyond reckoning.† It enables us to explain how chemical combinations can be quantitively the same while differing qualitatively. Certain atoms can in fact occupy symmetrical positions; now it is known that in "Geometry of Space"§ symmetrical volumes can in general no more be superimposed on one another than the glove of your

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[*] Van t'Hoff: *Leçons de Chimie physique.* (Paris, 1900)

[†] G. Monod: *La Stéréochimie* (Paris, 1895)

[§] After Plane Geometry, one proceeds to the study of Geometry in Space, that is, of three dimensions.

right hand on that of your left.. Such bodies, formed of an equal number of identical atoms but differently grouped, having consequently the same rough formulæ, have been termed *isomeric*.

That was the triumph of atomism; it was not to last for long.

In proportion as the facts accumulated, the most convinced partisans of the new method were obliged to admit to themselves that even the development of the formulæ in our own space of three dimensions was unable to supply an explanation of all the cases of isomery clearly ascertained* At the present time the new theories are far from seeing all their consequences, so much so that M. Freundler could say that "Stereochemistry has now reached a point where on the one hand it has given us all it can, and on the other its imperfections, more apparent as they are every day, necessitate its complete transformation." †

Even in the domain where Stereochemistry has won its greatest triumphs, that of optical isomerics, one can perceive the first symptoms of decrepitude that foretell the final failure.

What shall we say of the Stereochemistry of the quintivalent azote, and of certain metals as to which, in spite of M. Werner's beautiful experiments, there remains much more to do if conjectures are to square with experimental results.

Chemists are therefore compelled to use all these plane or three-dimensional figures only as systems of convenient notation, as kinds of sketches, schemes, or symbols.

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* The number of combinations of Carbon combinations already exceeds 100,000, and increases by several thousands every year. Cf. Von Richter, *Lexicon der Kolenstoffverbindungen*. (Hamburg and Leipzig. 1900).

† P. Freundler: *La Stéréochimie*. Collect. Scientia (Gauthier-Villars, Paris).

Such is, besides, the true nature of modern Physics: "Entirely based on a scheme," writes M. Duhem, "it does not at all propose to go behind our perceptions in order to see what exists, but it aims at representing them by symbols borrowed from geometry or the neighbouring science of numbers.*

We may here repeat Riemann's words: "When there is a question of extending the empirical determinations in the immeasurably great or the immeasurably little, the metrical relations may become more and more inexact as soon as we pass the limits of observation."

In other words, all our sensible data are put to rout so soon as we go beyond the rough field of observation; more than that, we begin now to understand that our geometrical laws of Space, inferred from such extent as our senses allow us to imagine, which suffice for our every-day and common experience, cease to be valid from the moment we would overpass the limits of our sensibility.

When we consider a single atom, we are as little entitled to speak of extent as to ascribe to it qualities inherent in complex and molecular groupings. Brilliancy, colour, hardness, softness, density, malleability, flexibility, elasticity, power of expansion, tenacity, fragility, beauty, ugliness—these are so many words without meaning if applied to the atom.

We have no reason, *a fortiori*, to suppose that atoms must group themselves, that is to say must act reciprocally on each other according to the laws of three dimensions which our senses have suggested to us, which we have formulated by means of our abstractions and of our mind working on the data supplied by touch and sight.

These suggestions will, I fear, seem very audacious to many of my readers, but at the present time they are on the way to be entirely confirmed, and that in the most unexpected manner.

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* P. Duhem: *Le Mixte et la Combinaison chimique.*

While the introduction of a third plane in Space has been, we have seen, an extraordinary fruitful method in molecular chemistry, while the tetravalence of carbon, for instance, can be explained only by supposing that the atoms are grouped according to our conception of the three dimensions to which we are accustomed, certain well-known combinations, such as those of the quintivalent azote, have always proved to be inexplicable on those lines.

All is changed when the chemist introduces a fourth co-ordinate into his formulæ of structure ; all difficulties vanish as if by enchantment ; the notion of Hyperspace loses its character of pure speculation, since it supplies us with the explanation of the real ; but at the same time there vanishes for the natural philosopher the hope of ever arriving at a mechanical and sensible theory of the Universe.

These conclusions are not, really, at all extraordinary, if one takes account of the fact that certain chemical reactions must take place in the very heart of that complex little world we call an Atom ; with regard to which, as we have already shown, our Euclidian geometry had proved incapable of supplying us with a sensible representation of the phenomena.

Thus it is that Hyperspace, at first a mere hypothesis, makes its triumphal entry, through the world of atoms, into Physics and Chemistry.

" Laissez-les prendre un pied chez vous,
Ils en auront bientôt pris quatre."*

Thus allured, the adepts of mathematical Physics did not rest under the shade of their first laurels. For long a question of supreme importance has divided them: the nature of Ether. No doubt the electronic theory of matter suggested an attractive solution, since according to it all our substances may be considered as agglomerations of ether-atoms; but however suggestive the new doctrines might be, they were far from having resolved the essential question in debate.

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* " Let them get footing in your house,
They soon will make their quarters there."

What is ether? A medium in which all bodies come and go, a medium necessary to connect all the worlds of the Universe and to suppress what was formerly called action at a distance.

For instance, take a luminous ray from the Sun; it reaches us in 8 minutes and 13 seconds. How has it been propagated? Evidently under the form of an undulation.

But where there is undulation there is movement; and where there is movement, something moves: that something is ether.

Ether exists then, beyond question. What is its nature? That is another matter, as to which we shall find ourselves in the presence of two schools, as always, the ancient and the modern.

Lord Kelvin, Sir Oliver Lodge, and Helmholtz have upheld what we call the mechanical theory.*

For them, ether was a medium more rigid than steel, a property needed to transmit, without apparent loss, enormous forces to incredible distances, a medium endowed therefore with extreme elasticity. On the other hand, the velocity of light proved its density to be infinitesimal.†

We were therefore confronted with the most *bizarre* medium that it is possible to imagine; at once the most *fluid* and the most *solid* of all known substances: fluid, to allow the celestial bodies to move in it without apparent resistance: solid, to propagate the transverse undulations of light; finally, endowed with enormous resistance to tension in order to sustain the forces of gravitation.

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* Lord Kelvin: *On the Clustering of gravitational Matter in any part of the Universe.*

†It is known that the velocity of light is 299,880 kilomètres a second; the figure is exact within a trifle of 50 kilomètres.

Such was the former "mechanical ether": a sort of living antinomy combining the most contradictory characteristics; and if it had not been defended by some scientists who were eminent mechanicians, Science would have denied the theory at its very birth.*

"It was at the end of the last century that the mechanical theory of ether reached its highest development. Since then it has died, not by violence but by inanition. It had always been a monster, and we are only too happy to be able to reject it definitely."†

One of the greatest difficulties raised by the mechanical conception of ether concerns the explanation of the phenomena of gravity. When Newton formulated his immortal Law of Attraction he took care to pronounce no opinion as to the essence of the phenomenon; he said that "All happens, as if the bodies attracted one another," etc. One could thereimagine that they were actually pushed one towards another, that a kind of fluid connected suns and planets, acting on them by pressure, impulsion, or vibration.

Now all attempts at explanation of that kind, or based on similar principles, far from elucidating the problem have on the contrary made more evident the radical distinction between mechanical actions and those of gravitation; these latter, indeed, as Newton most rightly remarked "arise from some cause which

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*Cf. H. Poincaré: *La Science et l'Hypothèse;* and the beautiful work of L. Poincaré: *La Physique Moderne* (Flammarion, Paris.)

†P. G. Nutting: *Nos Conceptions actuelles sur l'Ether*, dans Rev, Gen. des Scices, Aneoût 1912 (Collin, Paris.)

penetrates to the centre of the sun and planets without losing anything of its activity; this cause therefore does not act according to the magnitude of the surfaces, like mechanical causes, but according to the quantity of matter."

From this we must conclude that if gravitation acted according to a mechanical action of the ether it should act on bodies in exact ratio to their surfaces. Now that is not what experience indicates to us, since attraction is proportional, nor to surfaces, nor even to volumes, but to masses, that, is to say to the quantity of material present.

2- Quite different is the conception of ether in the new Physics. In them there is no postulate concerning the medium in which the ether acts; it is only established that this medium manifests definite finite electro-magnetic properties.

Thus considered, the new ether is a very different thing from the old; it possesses, in fact, neither mass nor rigidity in the mechanical sense, and consequently neither density, nor even change of form, for its particles have no identity. "Since it has no identity, its displacements and its velocities are unknown to us."

And then, as M. Nutting very well expresses it,* the knot of the problem is this: "What kind of medium can possess real tangible action at its limits, and conduct real energy with a determined velocity, while itself destitute of both inertia and rigidity in the mechanic sense of these words?"

The question is neatly put, but far from receiving an answer. Yet many scientists are daily studying the problem from every side. The result of the closest discussions—and this is the essential point for our thesis—is that there is no possible explanation of the known phenomena if we do not introduce into the formulæ the fourth dimension of Space,

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*P. G. Nutting, *op. cit.*

That is as clear as daylight if one adopts the mechanical solution. If the opposite view be taken, it will be, above all, necessary to investigate by experiment the nature of electricity and the electric motor-forces, and up to the present time the mathematical method by four dimensions appears to be the only one able to account for the great law of universal attraction.

Thus, whether we consider the Physics of molecular bodies or of ether, we are driven to abandon the former atomism, so far as it is a mechanical theory of phenomena in a space of three dimensions, and to adopt what we may term "the atomism of Hyperspace," which is beyond our power to represent.

But here, for the ultimate explanation of phenomena, we shall encounter different modes of interpretation, among which it will be very difficult to choose.

Even if we admit that the introduction into our formulæ of a fourth dimension resolves all the difficulties, we shall still have to elucidate the most mysterious point of all: In what does this fourth dimension consist? Can we consider it as a kind of material extension (épaisseur) added to the three known spatial dimensions? Then, in what direction shall we place it? Along a forth co-ordinate perpendicular to the three first, someone may answer. Be it so: but we are not much further on, since, as we have already observed, such a notion is outside our knowledge and reach.

It is no more of a solution to say that, without our knowing it, we are actually plunged in a hyper-space, *i.e.*, one of four dimensions, for example; for space, as we know it, is nothing apart from material bodies. If there is hyperspace, the bodies themselves must have more than three dimensions; why then do we find such difficulty in imagining a fourth?

Perhaps we might give this answer: As soon as we descend to the ultimate particles of matter, which we do not see, everything leads us to believe that the qualities assigned to agglomerations do not apply to atoms. These then can enjoy the privilege of possessing four dimensions, *i.e.*, of simply changing their relations according to a peculiar mode which ceases when a certain quantity is reached.

And in fact does not experience justify us ih thinking so? If we take a certain number of marbles of different colours, the possible grouping of these spheres in space can be determined according to a mathematical formula. Now since this formula is at times at a loss as to the arrangement of the molecule grouping the same number of atoms, we are compelled to infer that such agglomerations do not take place according to the laws of our space. Here are premisses big with consequences, of which we shall make use in the following chapter.

We could also use the following argument: the atom of ether which we shall never see is only to be found in hyperspace—*i.e*,., it possesses the four dimensions. To admit that would be to explain everything; to make my meaning clearer let us go back a little and resume our comparison of the surface-world.

On a vertical wall, entirely plane, let us draw circles of various magnitudes, representing planets and suns. Let us choose one planet, say the Earth, and on its outline (the circumference of the circle) let us imagine, as in Chapter vi., surface-beings of an almost imperceptible density. Though they move round the vertical disc, we can suppose them to be held there, attached to the disc, so to speak, by a laterally-acting force, and therefore in a third dimension of which they have no conception. But if the centre of the disc attracts them, they will conceive a force analogous to that of gravity. The cleverest of them will succeed in scratching the outline of their disc and in digging pits in it; others will manage to leave the circumference and rise in the air like our aviators, Let us imagine also a fluid analogous to our gas and spread in an extremely thin layer on the whole surface of the wall; the scientists of this two-dimension world will conceive accurately the idea of this strange medium which transmits the radiations of the stars, which is a support, at once flexible and resistant, of energy; but they will be utterly unable to explain how such a medium penetrates, and as it were soaks all bodies, how, *e.g.* the heat of the sun, which to them is but a line, finds no insuperable obstacle when meeting that other line which forms the limit of their body, but enwraps them completely, thus baffling the most assured principles of their mathematical physics deduced from their geometry of two dimensions.

In the same way, in our world of three dimensions, we do not understand how the action of the ether is not transmitted according to the laws of our standard mechanics; instead of taking account of surfaces, it works in relation to masses, acting as if all bodies were transparent in reference to it, penetrating to the very heart of matter, and never stopped even by the most solid substances.

Who does not see the analogy here, and that it suffices, in order to explain all, to admit that the force of gravitation acts according to a fourth dimension of space?

The preceding example would equally hold good if we had placed our discs (suns and planets) on a curve-surface belonging to a sphere of immense diameter, and if we had supposed its interior filled with a fluid that transmitted all vibrations. Our two-dimension beings would, this time unknown to themselves, have inhabited a world of three dimensions of which their space would have been the limiting surface.

In the same way we could say that our space of three dimensions, as Metageometry * demonstrates, could be the limiting surface of an ethereal space of four dimensions, a world material like ours, but unknowable by our present senses. If it were so, if such a hyperspatial world served to support our own, ether would penetrate us by the fourth dimension. Thus would be explained the strange, but actual, fact of of ether being able to come into contact with every part of our bodies.

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* Cf. E. Jouffret, *op. cit.* p. 214 and Chapter ii,

Here we are in the midst of mystery, and those who have pinned their faith to an atomism mechanical, geometrical, or dynamic, are at the present moment forced to disown their system and to "burn what they have adored."

CHAPTER IX

WHAT IS MATERIAL SUBSTANCE

WE must now approach directly the problem of the essential constitution of Matter, a problem which bristles with difficulties of which we have already had a glimpse, and which I would compare to a perfectly fortified and almost impregnable stronghold. So far we have only dealt with the outworks, but the time has come for the general assault, and for this we must neglect no help, from whatever quarter it may come.

Let us begin by defining Matter; cleverer brains than ours have often failed in the attempt; let us first eliminate what does *not* constitute its essence, a problem difficult enough for our weak powers.

There exist outside of ourselves objects which we call *material*, which manifest themselves to us by acting on our senses and exciting states of consciousness through the medium of our bodies, which are also material. But in order that these actions may be felt by us, the material objects must be present in sufficient quantity. The phenomena of sound, light, heat, even of extent, always indicate the simultaneous existence, exterior to ourselves, of material things in considerable numbers. For us, therefere, the main characteristic of material bodies is their *multiplicity*.

From the complex and multiple Physics enable us to descend to the simpler elements; first the atom, which is still a complex structure which we have succeeded in dissecting; then the electron, and, perhaps, the ether particle in ultimate analysis; for all existing facts compel us to recognise the minute granular and therefore discontinuous * structure of every ~~spices~~ of matter.

Whatever point we reach in our investigations, we are already sure that molecules and atoms—which we shall never see—lack almost all the properties which we attribute to material things. This applies even more empathically to electrons or still more minute particles.

We have seen that a material particle which has arrived at this degree of divisibility, is neither black, nor white, nor of any other colour; it is neither transparent, nor opaque, nor dull, nor brilliant; it does not, and because of the very nature of light could not, possess any optical property. By itself it is incapable of producing sound or colour.

This is true, *a fortiori*, as applied to the ether particle, on the assumption that this particle represents the ultimate term of natural substance.

It is to be noted, also, that all these things—sound, colour, and the rest—could in no way constitute a substance; at the utmost they represent only qualities or attributes of the substance.

Substance, according to the etymology of the word, means the *basis* of phenomena, which remains unchanged in the midst of unceasing modifications and various modes of existence.

For a long time men of science flattered themselves that they had at last attained, if not to the essence, at least to an essential property, of all matter, in what was termed the *mass*. But the Physics of the electron, as we have shown, have undermined this last bulwark.

When considered in reference to so slight a particle, the mass depends entirely on the velocity: it is even more than probable that it is entirely due to displacement. Have we at last reached the substance itself? Nothing justifies us in thinking so. According to the hypothesis, the ultimate particle is indivisible, and if velocity and substance are one and the same thing, it seems that by annulling velocity we annihilate substance.

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* The word "discontinuous" is not to be understood here as relating to space: it only indicates *multiplicity* of infinitesimal elements without presupposing them extended or unextended, or a molecular vacuum.

But we need not state the position in quite so extreme a form; we know from experience that velocity is susceptible of increase and decrease. If then we diminish a given velocity, without reducing it to zero, what is the final result of the operation? Evidently it effects at once both velocity and substance, with consequent loss of substance, *i.e.* with the same result as if the particle had undergone division; which contradicts the hypothesis, that assumes its indivisibility.

While diminishing velocity we should destroy substance; on the other hand, by increasing velocity we create substance. All this is absurd and shows that velocity is nothing but an accident.

But though an accident, does not velocity constitute an essential property of matter — as the "mass" was formerly held to be? In other words, can the material substance exist without motion, without displacement of some sort? A question of capital importance which raises a new problem, on which we must now enter.

When you open a text-book on Physics, you read at the outset such statements as this; "Matter is in itself incapable of activity. A body cannot put itself in motion, nor can it modify its own movement." In this consists the *inertia* of matter, defined by Galileo.

But who does not see that this is not Physics, but a complete theory of Metaphysics? And because such statements are found in a scientific manual, learners accept it without question. Yet how could Galileo verify the assertion that "a body cannot put itself in motion?"

Have we any example of bodies in a state of absolute rest? Do not modern Physics tend to prove the contrary?

Again, we are told that every movement finally transforms itself into a movement of vibration; that is the theory that heat is a mode of motion, from which we have inferred the notion of available energy which is constantly being wasted. Little by little the movement will diminish, and a thermal equilibrium be the final condition of all substances. At that point every agglomeration of molecules will show a temperature of—273°; that will be absolute rest, and further loss of energy will be impossible. But will this absolute cold correspond to rest? If we affirm that, we contradict all modern Physics, and perhaps also the older Physics, as a closer investigation will show us.

If by "rest" is meant that the molecules will not be able to effect any fresh "movements of translation," that is very likely correct; but the movement of vibration still persists, and there is no reason why it should be lost; or at least Physics do not furnish us with one.

If the sum of motion must remain constant, I quite conceive that the "movement of translation" transforms itself and affects simultaneously all material particles; but I cannot see why these particles should in time wholly cease to vibrate. What would energy have become? Where would it have gone? Physics after all have too often taught us to juggle with nothing, for us to be content with absurdities.

If absolute cold corresponds to total absence of movement, in other words to absolute rest, matter would have succeeded in itself modifying this state of motion, since this latter would have become nought. What was meant then by inertia? Obviously, the contradiction is flagrant.

If, on the other hand, motion cannot be annihilated, we must be able to find it again somewhere. Will it be in the ultimate particle reached by the man of science—in the ion or electron? But here we get out of our depth, for we know nothing of the nature of those infinitesimal quantities, if they do not still remain sources of formidable energy.

By applying Coulomb's law one finds, according to J. Perrin, that if two little spheres, one of which contains a milligramme of hydrogen ions, and the other 35.5 milligrammes of chlorine, are placed side by side, these two portions of matter attract each other with a force equal to the weight of 100 billions of tons! *

What is the secret of such activity? What becomes of the motion in an ion or electron? What laws can modify it? We do not know; but we do know that the word heat, if applied to the electron, has already lost its objective value. An electron is neither cold nor hot, just as it is neither coloured or transparent. Recent investigations, on the contrary, have shown us that what we took for inertia is not a property inherent in the atom, the molecule, or any material substance whatever. All the (supposed) effects of inertia come back, in the last analysis, to forces by which the ether re-acts to a variation of movement.

At this point we enter upon a series of phenomena of so abstract a nature and of such mysterious relations that no sensible representation can in the least connect them, since the empty space or ether will never be accessible to our senses.

Such has already been the conclusion that we have drawn from the study of gravitation, in so far as that is caused by ether, and from the intimate structure of the molecule considered from the standpoint of Chemistry.

Thus in the region of Physics, the terms of Mechanics lose all definite meaning, and we no

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* J. Perrin: *Les Atomes*, p. 69, (F. Alcan, Paris, 1912).

longer know by what essential properties we can determine the nature of Matter.

It is true that Mathematical Analysis is left us for exploring what we cannot see; if we wish to go further, we must come back to the elucidation of the problem of ether. And it is thus that scientists have come to declare that everything can be summed up in mere electric or magnetic phenomena.

We are thus brought back, by another way, to the conclusions already outlined.

No one is able, at present, to give a representation of electro-magnetic phenomena; none of the mechanical models so beloved of English scientists correspond to the reality; further, we are sure that no one will ever be able to construct such a model, because the facts upon which the electro-magnetic theory, the best elucidated domain in the whole of Physics, rests, can never be reached directly by our senses.

For many years certain savants have hugged the delusion that they could regard facts of that kind as if they were phenomena of tension and movement in a mechanically displaceable ether, " but," writes M. Gustave Mie, "all endeavours in that direction have completely miscarried, and the present generation of scientists hardly understand why so entirely useless and complicated an explanation was so long cherished. The sole reason is that one draws back before a completed abstraction, which would carry away as by a hurricane the last tender zephyr of sensible representation which still plays round the atomic theory."

As to the atom itself, the same author adds, " it is completely prohibited to think that we can represent it by the notions of mechanics."

The difference between ponderable and imponderable matter (i.e. ether) would then be only one of degree. What we call the material atom would be characterised only by a particular position in the ether where the conditions of the latter have acquired enormous intensity.

"Starting from this extremely abstract conception of Matter, the Physical theory of atoms has hardly anything in common with the philosophical conception. This latter tends to regard the (material) universe as composed of phenomena produced by a single unique substance, the universal ether." *

These quotations from Dr. Gustave Mie sum up briefly the present acquirements of Physics in this mysterious domain of the constitution of Matter.

They show, as was long ago suspected, that all the words formerly used in Physical Science, such as inertia, energy of position, forces applied to a material point, heat, etc., are mere labels.

In what can a material force or an energy consist *without* substance? And conversely: What is a substance *without* energy and *without* force?

And when it was asserted that Matter is unconcerned with the state of rest or movement, surely that was to misuse the meaning of the words, to take a metaphor for a reality.

The proof of God's existence from movement Q.V. receives thus a valuable confirmation, supplied by the new Physics.

If movement is in fact an attribute inseparable from Matter, we may not only ask who has made it pass from a state of rest to that of movement, but we must then seek for Him Who has created it in motion. For if by a purely logical and perfectly legitimate abstraction we can mentally separate the two concepts of Matter and movement, this is no proof that in fact God created it without movement. But since the fact of movement is established, the argument used to demonstrate the existence of a First Cause of this movement stands in all its vigour.

We are scarcely more advanced, however, with regard to the constitution of Matter. But where Physics fail, the metaphysician can enter the lists and try to penetrate further into these mysterious regions.

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* Dr. Gustave Mie: *Die Materie* (Stuttgart, 1912).

The natural philosopher avows that what remains when Matter has been dissected, is on the one hand the substance, and on the other the phenomena, which can be reduced to states of more or less intensity and to movement. Let us analyse these data.

First of all, it is impossible to conceive a phenomenon *without* substance. The phenomenon is what changes; the substance is what remains identical behind the transformations.

We can therefore admit, with Balmès,* this definition of material substance: "A permanent being in which occur the changes presented to us in sensible phenomena."

What is this permanent being? I do not know, but I know that this being has visible characteristics. Substance appears to me under various conditions, modifications, modes of existence—under what philosophers have called *accidents.*

To understand this better, let us use an illustration from the substance of the soul, for though the soul is not material, it is also a substance that experiences modifications.

When I say "I wish," I regard my soul under a different condition than when "I think," but in both cases it is the same soul that is in question. The state, or modification, does not then impose a radical change on the substance; it is always the substance that is the cause of the modification.

We shall see, by a detailed study, what differences exist between soul and matter, but the two entities possess common points; both are *substances*, and that is why I have chosen this instance, familiar to us all, to illustrate the nature of the modification.

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* Philosophie Fondamentale, l. ix, Chap. iii.

The bodily substance, so far as it is the support of phenomena, may then be considered as their cause—*i.e.* the cause of its own modifications. Is not to *be*, indeed, to *act?* since what has no activity is comparable to nothing; it is only by this activity that we recognize the substance.

Just as the effect comes from the cause, the phenomenon arises from the substance, which determines the appearance of something which passes from non-existence to existence. Before the cause acts, the modification is not there ; only when it has acted.

We have already travelled far from the opinion of Descartes, the mechanical theory, "according to which bodies are merely inert, having no other activity or other quality than the local movement impressed from without." *

The Scholastic philosophers of the Middle Ages had already taught the precise opposite, and the Thomist Philosophy is explicit on the point.

We conclude, then, that the substance, cause of the modifications, possesses in itself the force which produces phenomena ; it is from that force, not from elsewhere, that it derives its energy.

These statements must not make people confuse our teaching with physical and chemical atomism, or even with pure dynamism. In all the atomic 1– systems the ultimate material particle is inert and purely passive, subject to mysterious external forces distinct from the atom itself. That is what Epicurus, Descartes, and perhaps Newton, taught.

In the dynamic system, of which Leibnitz is the 2 – chief exponent, the atoms are nothing but mathematical points, incapable of acting on each other ; their action is purely immanent.

The one school exaggerates the material part, and 1– does not really solve the question ; the other disregards the passive side ; it is clear that the correct –2 system must take account of both the activity and the passivity of the ultimate material particle.

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* Elie Blanc : *Transac. de Philos. Scol.* No. 686.

It is for this reason that the Scholastic Philosophy, while admitting the atom, or something that corresponds to its definition, proceeds further with its analysis: teaching a passive side, which it terms *primary matter* (common to all material substances), and an active principle which determines, which *actuates* the matter, which can make it pass from potentiality to act, in a word, can modify it: this the *substantial form*, from which the *force* is derived.

It would go far beyond my purpose to carry further the analysis of this system; but we may remark in passing that it is the only thing which explains, and that in a wonderful manner, the alliance of Force and Matter, since it is the substantial form that is the secret of the activity of material substance.

Thus every material substance is made up of "first matter" and of force (or "form" in the metaphysical sense); the one cannot exist without the other. But we are acquainted with substantial forms or forces which can subsist without matter; such is the human soul, and at the right time we will prove this capital proposition.

What we must, before all, deduce from this excursion into the domain of Physics is that all, even material, substance is essentially active, and that it is only through this activity that we can arrive at any knowledge of it.

While the passive element, what philosophers call *first matter*, will for ever escape the scientist, he will succeed by his experiments and analysis, in determining with increasing precision the various modes of activity manifested by the material substance, and, at the same time, the various aspects of its energy.

The more perfect our experimental technique becomes, the more clearly we shall see that *inertia* is a word without meaning as applied to the ultimate material particle; and if the savants of past times had been more of metaphysicians they would have admitted the idea of the "mass" only as a function of some force still undiscovered, since from the philosophical standpoint this could not depend only upon matter.

However that may be, we now understand better why the material substance reveals itself to us under the aspect of a true activity, as a cause, or a force, in the proper sense of the word.

For this reason I shall, during the remainder of this book, often use, for the sake of brevity, the expression *material substance* instead of *last particle of material substance*, thus designating the part as the whole—the activity or *force*, the sensible token of the material particle, the side by which it acts on our senses.

You now begin to understand into what confusion the older scientists, who have bequeathed to us the principles of standard Physics, have thrown us through neglecting to base their science on precise definitions. Little by little their successors have come not to know the real meaning of the words they used, and to forget that most of their terms were in fact mere labels.

Thence comes the apparent discord between scientists and philosophers. Accustomed as we have been in our study of Physics to look on the material force as something apart from, instead of an essential* quality of, all matter, we have failed to perceive that this entity—Force—is no more mysterious than Substance, another necessary entity no doubt, but

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*Instead of *essential*, we could use the term *inherent*. "Some scholastics have thought that the primary matter could, strictly speaking, exist without a substantial form; but this opinion is absolutely rejected by St. Thomas. It is contradictory in itself, and destroys the system." Elie Blanc: *Traité de Philos. Sc.*, Tome II, p. 657, which we never see, and yet to which we are obliged to relate all phenomena.

We know now that these sensible phenomena, colour, sound, odour, weight, etc., are but secondary effects, caused indirectly by the substance; that the true cause is still hidden behind a concealed rampart; that we must, in one word, as we have already seen, abandon all idea of sensible representation if our mind desires to reach the real Substance.

But we know that, having come to this last stage, we must find a matter endowed with Force, composing, so to say, the stuff of the Substance, the ultimate support of material phenomena. These real activities cannot however exist in infinite number, since they really exist; and since infinite number, as we have seen, is essentially unlimited and could be realised only by an Almighty Being.

On the other hand, the concept of Force is *simple*, like that of Cause. Forces cannot be analysed except by a purely ideal and geometrical convention, and it is as impossible to conceive half a force or half a cause as to conceive half a soul or half a substance.*

It follows that the last material particle consists of a simple and indivisible substance, and since the concept of extent implies, as we have demonstrated, multiplicity, we may conclude that this last material particle (or force) is unextended.

Considered therefore only from the scientific and rational point of view, no material particle can be destroyed. The word "dematerialisation" of matter, used by Mons. G. Lebon has, metaphysically speaking, no meaning, since destruction can only apply to a composite body, and as far as it is composite.

The pen which traces these lines, and the hand

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*In his admirable *Étude sur l'Espace et le Temps*, M. G. Lechalas shows by unanswerable arguments that Cinematics, the science of motion in Mechanics, is purely geometrical. Cf. Ch. v.

that writes them, will be destroyed in the sense that the materials which compose them will be otherwise grouped. Will they return to Ether by some unknown mechanicism? I do not know, and it is of no importance, but what I can affirm is that the forces which enter into their composition cannot of themselves cease to exist as material forces, because each of them is simple, and therefore indivisible and unextended.

I have said: "The material forces cannot of themselves cease to exist"; here a word of explanation appears necessary.

We have seen that a Cause is *in itself* a productive force; it possesses the power to make something pass from non-existence to being, but only with respect to modification, or *accident*. No power, other than God, can produce *subtance*, which He at His will can create out of nothing. Conversely, for material substance to disappear, God must intervene and will to annihilate it; the passing into nothing of a material particle could not be conceived otherwise.

Would God, Who has willed to create material substance and Who maintains its being by what theologians call Divine Co-operation, will some day to annihilate it? We do not know. St. Peter declares that there will be new heavens and a new earth, but there is nothing to tell us of what these new worlds will be formed, and in what degree our present forces will enter into their constitution.*

There remains the well-known objection: How can the extended be formed of the unextended?

I might be content to reply by basing my argument on analogies. Extent is a phenomenon of sensible intuition; why then should it exist outside of me as it does within me? You distinguish perfectly the subjective from the objective when it is a question of sound, light, and odour. There is then no reason why the subjective idea of extent should better represent the objective extent than a note or a colour the molecular vibrations.

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*We shall quote later on a whole series of texts on this subject. Meanwhile this is the passage alluded to: "But we look for new heavens and a new earth according to His promise, in which justice dwelleth." (II Pet iii. 13. Cf. Is. lxv. 17, and Apoc. xxi. 1.)

But we can try to penetrate further into the mechanism that enables us to grasp the idea of Extent. Without laying down any postulate as to the objective extent of the ultimate material particle, we have shown that the notion of extent essentially implies but two ideas: multiplicity and relation. Multiple material forces, by their reciprocal action and in relation to myself, can perfectly well constitute Extent, at once subjective and objective, and that we are about to demonstrate.

Let us lay down in the first place that it is enough for material forces to act simultaneously on a more or less considerable part of my body, to arouse in me the idea of continuous extent. I shall estimate the objective magnitude of the force in proportion to the response of my nervous system. The elements that compose that system, spread in myriads over the periphery of the body, are constantly connected by nervous threads to the ganglions of the brain. We possess, then, as in a telephonic network, a transmitting apparatus connected by separate wires with the central station; the number of calls on the "multiple" indicates to the telephone-clerk (our brain) the number of wires affected.

The terminal network, formed of distinct nervous elements, at first informs us, usually, in a way only partly exact, and with limited precision. which is developed by education.

Take a compass and divide its points; place these on various parts of the body, and you will discover a very curious phenomenon which was first described by the physiologist Weber. For the two points to be separately felt by the extremities of the fingers the space between them must be greater than two millimetres; by the tip of the nose, which is much less sensitive, the two points will be felt as one even if separated by five millimetres; on the back, even a greater interval would be unrecognized.

On the contrary, the tip of the tongue is exquisitely sensitive; two points separated by only one millimetre are distinctly perceived. That is why we know the inside of our mouths in such detail, and are so sensitive to every sensation in it.

Thus, except with regard to the tongue and the finger-tips, our sense of touch, so far as it gives us the notion of extent, is extremely limited. We must, moreover, in order to be informed of the notion, add the movements of our fingers and hand.*

We have said that education plays an enormous part. Everyone knows the refined sense with which the blind differentiate objects by touch only. Saunderson cites the case of an old blind antiquary who thus distinguished a genuine medal from a spurious one. Most blind card-players identify the cards by merely rubbing them; they distinguish in the same way between differently dyed stuffs.

In spite of this immense sensibility, our sense of touch is powerless to make us cognizant of the molecular *vacua*; the nervous corpuscules which notify a tactile impression are $\frac{1}{10}$ of a millimetre in diameter; those of the mucous membrane of the tongue, though less ($\frac{1}{30}$ of a millimetre) are immensely

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All this section of Physiology, which is studied under the title of *Tactile Sensibility*, is extremely complicated. It is a mistake to think that all points of the surface of the skin are sensitive. We must even distinguish between points sensible to pressure, and points sensible to heat or cold. According to Von Frey, the points of pressure are 500,000, distributed over the whole body, with the exception of the head. Points of heat: 30,000. Points of cold, 250,000. Cf. E. Gley. (J. B. Baillière et Fils, Paris, 1910).

greater than that of the molecules or the intervals which separate them.* The elements of the retina, reached by the light which emanates from what we erroneously call the surface of bodies, are of enormous magnitude when compared with the ultimate particles of matter.

The subjective sensation of extent cannot then give us a representation of matter exactly as it is in reality, and only an ignorant person can henceforth inquire how exterior objects exist.

But what I *am* certain of is that they *do* exist, that they are composed of substances which act upon my body. These distinct material forces, in relation with myself and with each other, constitute Extent, which is not therefore a purely subjective idea, as idealists would represent it. Since our sensation of Extent corresponds to multiple external causes, to an *amount* of Matter, an objective Extent cannot but exist.

Thus, from the fact that various material forces act simultaneously, and each on its own account, on my body, I acquire the notion of Extent.

The same is true with regard to Motion; since the successive perceptions caused by the point of my compass affect various elements of my body, they give me the idea of material movement, by education, I quickly apply this notion to visual phenomena.

Objectively, Motion may be reduced, as we have seen, to pure relations of Space, to relations between external material forces, and here we again find ourselves in Metaphysics.

If Substance is essentially active, it is the seat of constant modifications, of changes, i.e. of movements in the strict sense; but while I easily conceive, by my varying states of consciousness, movement and change within myself, I cannot grasp the external activity which manifests itself by its relations with other external forces.

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* Cf. J. B. Chatin: *Les Organes des Sens.* (J. B. Baillière et Fils, Paris.)

It is however a fact beyond question, as experiments show us, that the material elements, which are at once substances, forces, and causes, act upon each other; but what is the mechanism by which this action takes place?

It explains nothing to say that one force is added to, or substracted from, another. Since motion is synonymous with change, I may say: If A changes, B also changes; but though the modification in A is identical with that produced in B, I know perfectly well that the modification in A is distinct from that in B; in other words, nothing has gone out of A to enter B.

When I consider what occurs in myself, I perceive very clearly that I can produce various states of consciousness; I easily grasp the idea of cause and effect, though I know nothing as to the "*how*" of the phenomenon. Philosophers tell us that here we are in the presence of *immanent actions*; but I know also that I can act upon my body; by an act of my will I lift my hand; but *how* my soul, by a particular state of consciousness, can cause the movement of a material substance, I have no idea; if I could understand that, I might perhaps be able to explain by analogy how two material elements, or forces, are able to act upon each other.

But let us return to Extent: although the "problem of action" remains for ever insoluble, we begin to understand that of Extent, which, objectively, implies only two things: multiplicity of material forces, simple, indivisible, and unextended, and simultaneous relations between these forces; and when I say "relations" I mean reciprocal action between the forces. If I can verify these two conditions, the idea of Extent is inevitably formed in my mind, and at the same time that of the external world formed of multiple and complex elements.*

There remains the question of the continuity of Matter; but it is obvious that the solution of this problem debated by the philosophers depends, *au fond*, on the definition of "continuity." The question can exist only for those who hold that space can exist *in itself*, a theory which now-a-days has no champions; no one still dreams of *action at a distance.*

When one material element acts on another we say they are *in contact* with each other, and since all material substances react on each other we can, by the definition, admit in this sense the real continuity of Matter; but this continuity cannot be perceived by sensation, as we have already proved in studying the *Physics of Space* (Chapter IV.).

You now understand better the deductions we have drawn from our study of Hyperspace.

From the sensible data, deduced from facts and in correspondence with them, we have inferred the idea of Extent, the general notion of Space, and have applied our calculations to it. Thence is born our Geometry, daughter at once of experience and of reasoning.

But—and this for the philosopher is the essential point—this Euclidian Geometry which we keep up because it is adapted to, and sufficient for, our present needs, contains propositions which are only "the simple expression of propositions particular to our own Space . . ." The possible Geometrical forms are not limited to those which can find place in our Universe, to those which our imagination is able to represent. There are others conceived by reason which could be realized in another universe, which other imaginations could furnish.*

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* Here we are only discussing the genesis of the *idea* of Extent. Philosophers, especially Balmès, show very clearly that even without reflection, they recognize the objectivity of visible bodies. Animals, children, and most men, have never *reflected* as to Extent, but all recognise it objectively.

We can go still further: the spatial relations which we see, and which occur according to laws which account for the phenomena accessible to our senses, are not the only ones that exist. The ultimate particles of Matter have more means to communicate their activity—to enter into reciprocal relation—than the rough masses of matter which alone affect our sensibility.

This is the only possible explanation of the phenomena to which we are led by the study of the inorganic world. The analysis of living bodies will now enable us to put our finger on the radical impotence of Mechanics to provide us with a plausible theory of the structure of the organic Universe.

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* Cf. G. Lechalas: *Op. cit.* p. 120.

CHAPTER X

THE FAILURE OF MECHANICS IN BIOLOGY

GEOMETRICIANS tell us that to propose a problem well is a long step towards its solution. The apparent paradox of this old adage disappears if one admits in principle that the whole solution is contained in the data; to our logic is left the task of elucidating them by applying to them known laws.

Every living substance is composed of definite chemical elements, and if our standard Mechanics are, as we have seen, unable to give us an explanation of certain complex molecular structures, it is *a fortiori* not surprising if they fail entirely in the domain of Biology, in which the most baffling chemical combinations present themselves.

Yet it is not to this failure that we beg for special attention.

The phenomenon of life, we must confess, is not to be easily defined; but if it is accompanied by always renewed, and therefore universal, conditions, we shall succeed perhaps in applying to it a sum of characteristics which may finally enable us to distinguish life from what is not life.

"Life," said Bichat, "is the entire sum of the conditions which resist death"*; a poor enough definition so far as the mere words go, but yet concealing a depth of view worthy of the great physiologist.

When we consider the series of beings subject to our sensible investigation, we at once recognize a broad distinction: some appear to us inert, like a lime-stone or a block of metal, while others enjoy a constant mobility, like an animal. From this arises, no doubt, the common idea that all life consists in purely mechanical movement.

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* X. Bichat: *Recherches Physiologiques sur la Vie et la Mort.*

Now we know that a locomotive has only the appearance of life; that the watch we wind up every night, though it does not stop, is not alive. The distinction, too, would be purely artificial, for the study of the apparently most inert bodies has revealed them to us as a complex union of particles in constant motion, some of which revolve round a kind of sun in true planetary orbits at the rate of 600 to 1000 billion revolutions a second.[*]

In the most resistant metal block there is then an unceasing struggle of atoms. Exteriorly, oxidization causes great modifications, but if you could penetrate to the heart of this inert body, you would assist at strange battles: unsuspected chemical reactions, exchange of atoms and particles, transformation of materials, molecular activity which little by little will produce profound modifications in this mass, apparently homogeneous and indestructable. That is why some scientists have ventured to speak of "life" in connection with matter.[†]

But all this, as we shall show, has nothing to do with the phenomenon of Life; mere physical motion is not its essential characteristic.[§]

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[*] J. Perrin : *op. cit.*

[†] Ed. Guillaume : *La Vie de la Matierè.* A most suggestive address given before the Société Astronomique de France (Bulletin 1900, p. 480).

[§] Philosophy proves that material substance does not possess life. We have seen that it is not merely passive; the "substantial form" is a principle of activity and motion; but if the purely material molecule shows apparent spontaneous movement, in some way, that movement has neither true Spontaneity nor Immanence—which are the two distinctive characteristics of Life.

What then must be present for us to be able to affirm that a being really possesses Life?

Let us proceed in our examination. Here is a very little ant, just hatched, and already it walks, runs to and fro, unceasingly. Scarcely begun to exist, its first care appears to be to preserve its life; it must swallow and assimilate food, repair the waste of its organism, and then begin again without ceasing; briefly, it must set agoing a whole physiological workshop, where nourishment is transformed, as in wonderful crucibles, in order to keep its organs in repair, to replace the machinery that is worn out and deteriorated, until the time when the parts of the machine have no longer power to fulfil their functions and it stops: this will be death.

Now we grasp Bichat's definition: "Life is the entire sum of the conditions which resist death"; the living being, this marvellous mechanism which appears at a certain moment of time, which manifests at once its own special autonomy, which controls its own movements, which performs, in the midst of surroundings often changing and sometimes hostile, precisely the actions necessary to gain the maximum of resistance; which selects therefore the materials designed to assure its preservation and the continuation of its species, for this complicated machine possesses the wonderful power of reproduction.

All the mechanism of the living being will therefore be employed to preserve as long as possible the integrity of the organism which makes it an individual distinct from surrounding objects, to compel Matter to take this or that course, to force the molecules to assume this or that combination so that it may realize the best for itself.

At first sight, so peculiar an organization seems in no way to recall our machines, which neither work by themselves nor reproduce their kind. That is why the Thomist Philosophy has defined the living creature as "that which possesses within itself the principle (or cause) of its movements."

A special force, distinct from the rough inorganic matter, appears then to subsist within these organisms; it presides, so to speak, over the actions of the living being; from this conviction have arisen all the "vitalist" theories, exceedingly various but all admitting the necessity of a force outside Matter.

Mere illusion, the "mechanist" school reply; in the living creature the physico-chemical forces are as evident as in inorganic matter, and are themselves sufficient to explain Life.

This time the problem is put clearly. We must choose between some form of Vitalism, and Mechanism.* Whatever school we follow, we cannot shut our eyes to indisputable facts. The living creature manifests from its birth a tendency to an *aim*; while subjected to a certain degree to physico-chemical influences, it persists none the less during its whole life in that innate tendency, and in order to realize it fully it acts, as a matter of fact, as if endowed with an intelligence that disconcerts the most sceptical.

How can material molecules, blind forces acting by necessity, agree to group themselves in order to reach the same end?

This end, the mechanist will reply, is merely apparent; it corresponds in the living being to the "maximum of stability," to which it is led inexorably by external forces.

Heap up a great mass of heterogeneous materials, construct a vast building with them, and leave it to be acted on by time; all external causes, what geologists call "external dynamics," combined with gravity, will gradually prevail. In a few centuries there will remain of this splendid palace nothing but rubbish, a formless mass in which every stone and every molecule will have taken the only place where it can permanently lie; the "stability" will have reached its maximum.

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* We do not enter here into the details of the question, or attempt to state the different Vitalistic theories from the philosophical standpoint; the sequel will show which doctrine we should choose. (See Chap. xii).

Precisely the contrary happens in a living organism; its materials are as unstable as possible, and the creature that uses them will struggle during its whole existence to maintain the equilibrium of this precarious organism.

When the archaeologist stands in front of a Gothic Cathedral, some grand and imposing edifice erected by the faith of our fathers, he, while wrapped in admiration of such mingled grace and boldness, soon discovers with his trained eye the successive touches which an architect, however clever he may have been, has subsequently added, and the repairs which have been executed for its preservation. The more frail its carving, the more beautiful its ogives and rose-windows, the more delicate its arabesques, the more necessary have the subsequent restorations been.

Nothing of all this can be compared with the living being; in the latter, the structure of the organs is so complex that it realizes the minimum of stability; nothing can destroy its equilibrium; one might imagine that blind external forces had agreed to maintain it in repair, to preserve and support it! Naturally, they would rather combine to demolish rapidly so fragile a structure. But if there is no exterior architect to secure the perpetuity of the building, we can only conclude that his place is evidently within.

If such a series of operations were to take place in the same unvarying round, mechanists would get off cheaply by invoking Evolution, that *deus ex machina* which has never explained anything, but at each moment is obliged to change its tactics and its operations; everything, however, compels us to compare this interior force to the commandant of a beseiged fortress, unceasingly adapting new means of resistance to the changing plans of the enemy. His work, to revictual his army with forced and uncertain supplies, to sustain his effort at various points, to organize the defence by what means he can, to arrange sorties, to repair breaches, and keep up the *morale* of his troops, in a word to foresee, to organize, to adapt, and to act at whatever cost, is this not a type of the struggle for life? For life is, above everything else, action and organization of means to an end, the effort to realize a plan; does not such a tendency imply a special force for such a conflict?

That of the myriads of atoms scattered throughout the Universe, some thousand millions could be collected in a definite point of space to produce accidentally an organized molecule is as improbable as that a poem could be composed by mixing up all the letters in a typographical fount; but however astonishing, let us admit its possibility; we have still to explain how this fantastic agglomeration, once and accidentally realized, can successfully oppose itself to the mechanical forces perpetually at work to destroy it; since (and that is a law which has not been invalidated by the new Physics) all Matter tends towards a kind of dynamic equilibrium as to its final state.

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What mechanism could we imagine, to preserve from this law of Nature a system of atoms which creates itself and claims, so to say, the prerogatives of instability? Still further: such a system if vanquished by force is but momentarily destroyed, because it possesses the power of reproducing itself under an identical form at the very moment of defeat, a strange perennial phenomenon, still more mysterious than the sudden apparition of the phenomenon which it perpetuates.

Harmonies and tendencies can be explained only by an *idea*, by a plan conceived and willed in a definite direction.

This teleological point of view has not escaped the notice of the most enthusiastic promoters of physical and chemical experiments in the study of living beings. The most extreme upholders of complete evolution are compelled to introduce, or rather to accept, the notion of progress in Nature; but to state a phenomenon is a matter of purely experimental science and does not explain it.

Empiricism does not go beyond the *datum*, and if it proposes a law it only collects a series of phenomena, without giving a reason for them; it records the effect, but forgets to trace it back to its cause. To proceed thus is not, properly speaking, to practise science, but to label results, of the nature of which it is contentedly ignorant, and which it artificially classifies.

Does it follow that we must reject all such processes? Not in the least. By not consulting experience the physiologists of past days fell into the most serious mistakes, while those of to-day too often tend to exaggeration in the opposite sense.

It is absolutely necessary to collect data, to test facts, to produce phenomena, to press close to reality. From this point of view Mechanics have rendered undeniable service to Biology; the mistake of the extreme mechanicians has been in looking on that science as a solution of the enigma of life.

By stating *autonomy* to be the supreme vital fact, the philosopher is entitled to ask what is its cause and to propose an hypothesis; and this time it is he who practises science, and his statement may seem paradoxical, but it is easy to justify it.

When a child tries to fit the pieces of his jig-saw puzzle, is it not an *idea* that guides him? What is his aim? To restore the original picture pasted on the fragments of wood, and which are cut up into strange shapes; in a word, to put the details in order to arrive at the whole.

It is the same if, *e.g.* the puzzle is a geographical design; he must in some sense imagine the whole, and then work it out till completed. He starts therefore from a hypothesis, and as he works he soon finds if he is on the right track.

The man of science acts on the same principle; he first observes, he collects his materials as best he can, investigates, *e.g.* all the properties of light, groups together facts of the same kind, and if he is in the least degree a philosopher he frames, as he goes on, numerous hypotheses. He soon perceives that this or that fact will not fit into one of the moulds he has conceived *à priori*; then he proceeds by successive eliminations, until all the facts square with the hypothesis.

An admitted hypothesis, then, only holds good until the discovery of some new fact which invalidates it.

If we now return to Biology and apply these principles, the problem to be resolved will be extremely limited.

Either Mechanics will explain to us the ascertained autonomy of the phenomenon of Life, and we shall admit that the physico-chemical forces are sufficient to explain it; or else we shall discover, among the phenomena of which the organism is the stage, facts which Mechanics are totally unable to explain, and the autonomy of the living being will demand a force distinct from rough matter, whatever label be affixed to it. We are thus led back to the same dilemma.

It is impossible in so brief a study to notice in detail all the numerous objections to the mechanist theory; we shall only indicate the most typical at the present time.*

Au fond, the whole controversy lies in the following question. How does it happen that in a living creature, even of a low organisation, every part of the body has its own function, to which it seems adapted?

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* We have in this chapter borrowed more than one idea from a recent study by Dr. S. Jankelewitch: *Le phénomène vital d'àpres récentes données de la Biologie et de la Médecine.* (Extrait de la Semaine Médicale, Paris).

It is impossible, *e.g.* to deny that the organ of sight is adapted to the function of sight. There is a whole detailed system marvellously arranged, and obviously in view of a desired end.

Lens, diaphragm-iris, accommodation, sensitive plate—all these function in the eye as in an ideal photographic camera.

"The function creates the organ," it is said, and the attempt is made to show how the sense of touch could, by differentiation, give birth to complex organs (as the eye or ear) adapted to the various external radiations; but it is forgotten to add that all these assertions are outside experience. Even if this hypothesis were verified, the philosopher would still be far from being convinced. When it is asserted that the function creates the organ, no attempt is made to show why the function comes into being, and the problem remains intact.

Why should there be one function here and another there? And why is our organism but a series of functions united to form a true individual? It is, so reasons the vitalist, because within the organism there resides a peculiar force which disposes and rules these functions.

An utter mistake, replies the mechanist. The older physiologists, in asserting that the function creates the organ, had only gone half-way; we can satisfy you completely: the force is not within, but without. It is the external medium which acts on the organism, and compels it to perform a succession of reactions directed to a fixed end.

Well and good: after all I prefer this new position so clearly laid down; the battle can be fought in broad daylight.

This hypothesis, founded to a great extent on the labours of Mr. J. Loeb, some years ago was very popular: it is the theory of *Tropisms*.*

A plant, we know, seeks light, and turns as far as possible towards it: Phototropism, says Mr. Loeb. The roots of the plant strike into the ground; that is quite simple: Negative Phototropism.†

Animal movements are more complicated; don't let that be a hindrance; we will invent the requisite terms: Stereotropism, Galvanotropism, Thermotropism, and so on indefinitely; thus indicating that the action resides outside and that the reaction of the organism is excited either by a solid agent, by a chemical combination, or by some kind of electric phenomenon—and so on.

Let us take an example to make the theory clearer. Here is an amoeba (a protozoon) says Herr Werworn; it reveals itself to us as a ball of protoplasm, which throws out suddenly in all directions what have been termed pseudopods, a kind of filaments comparable to a snail's horns, which stretch and shrink at will, and which serve it in some degree as organs of touch and movement; if we excite one of these pseudopods it shrinks and rejoins the mass.

The phenomenon is thus explained by the tropist theory: the external oxygen destroys the equilibrium of the protoplasm, hence these configurations, which, breaking up the spherical form, appear to us under the form of pseudopods: hence, Chemotropism. But our pseudopod when excited loses some of its constituent elements; to set itself up again it must go back to its source, the nucleus of the cell which contains the nutritive part of the protoplasm; hence a contraction, and therefore: Internal Chemotropism.

The cell being the ultimate term of the living, organic creature, we conceive that we can generalize, and affirm that from these simple acts is derived the whole series of phenomena that concern a more highly differentiated organism. The contractions of our muscles belong to the same order; we believe that we *will* when in fact we necessarily respond, by a reaction imposed on us, to an exterior action: always a Tropism!

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* From the Greek τρόπος (direction).

† J. Loeb: *Studies in General Physiology* (Chicago).

Now let us take the trouble to go to the root of the matter, and we shall see that the upholders of the new doctrine merely succeeding in formulating statements. That is exactly the "vertu dormitive" —the soporific—at which Molière laughed so heartily.

To say that the cell reacts in virtue of any tropism whatever is to substitute a phrase for the required information. How can these "tropisms" or rather these actions of an external medium, succeed finally in securing the preservation of the organism, be it cell or animal? since, wherever they come from, it is here they end in their ultimate analysis. If this is so, we must suppose that there exists some pre-established harmony between the vital needs of the organism and the actions of the exterior agents. If we are content with that—with transferring the final cause from within the living being to outside of it—we do not in the least escape the difficulty.

It is surely, in view of all the facts, much simpler and more natural to assign to the living organism the power to perform the acts most fitted to secure its conservation, than to suppose this to be accomplished by multiple and various exterior agents.

These however are metaphysical arguments, and mechanists will have none of them; but we have others to offer them.

Without entering on Mr. Jennings' recent experiments, which have adduced facts irreconcilable with the tropist theory, * we are aware of a whole series of phenomena which theorists have tried in vain to reduce to Physico-chemistry.

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* H. S. Jennings: *The Behavior of the Lower Organisms* (New York).

It has been endeavoured to explain by osmose the passage of the alimentary solution through the wall of the intestine, but both experiments and physical laws give totally different results in the case of a dead membrane and in that of a living creature. The intestine wall, as well as that of the delicate canals of the kidneys, "presents, in addition to its physical properties, others which cannot be reduced to Physics and which we may in the meantime qualify as vital."* It is probable that every cell of these walls exerts its own activity on the aliment, first to select and then to trasmit to the other side the elements chosen as sustenance.

"Insufficient as it is to account for intestinal absorption, the physical theory shows itself utterly powerless to give a more or less plausible explanation of the absorption of fats and albumenoids."

The attempt has been made to consider chlorohydric acid as the effect of an electrical dissociation, effected through the wall of the stomach, between the alimentary ions and those of the blood. But M. Pavlov's experiments have treated this explanation as it deserves, by showing that under determined experimental conditions, and in certain morbid cases, an empty stomach can secrete gastric juice of an absolutely normal type.

M. Pavlov's works, to which we have just alluded, form, on the part of a savant unsuspected of anti-scientific prejudices, the most brilliant demonstration ever made of the insufficiency of the physico-chemical explanation of the phenomena of life. It is known that he has chosen, as the special object of his studies and experiments, the digestive processes. Now, taking as his own the aphorism of Bunge: "Nemo physiologus nisi psychologus," M. Pavlov does not hesitate to recognize in the action of the digestive glands the intervention of the psychic factor, and to apply to the study of this branch of science the frankly anti-mechanist point of view.

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* S. Jankelewitch : *Op. cit.* p. 25.

"The glands of the stomach and pancreas behave as if they had some kind of intelligence."* The eminent physiologist shows, in fact, that the digestive secretions are proportioned, not only to the quantity of aliment (an obviously mechanical phenomenon), but to their nature. It follows that the digestive glands take into account the end to be attained, and the means they employ are strictly proportioned to this end. One might even suppose that their activity is connected with the psychic appeal of the aliment, and this would explain why we digest better foods that we like, while those to which we feel repulsion make us sick.

M. Pavlov has conducted a whole series of experiments to test this anti-mechanist hypothesis.† He has even conceived the idea of giving dogs purely fictitious meals ; and that in a relatively simple manner.

If we cut the animal's œsophagus, and unite the severed extremity to an aperture made in any part of the skin, the aliment, in proportion as it is digested, will go out through this artificial aperture. The stomach plays no direct part in these fictitious meals ; it acts nevertheless, and its secretions, in their nature and quantity, act as if the food had followed the natural digestive channel.

Thus the stomach and the other digestive glands are warned, as if by agreed signals of what they have to prepare for the digestive action ; the psychical energy is obvious here.

M. Pavlov has gone further still ; he has obtained the same results in cases where the food did not pass through the cut œsophagus or even through the mouth. The mere sight of a meal sufficed to excite the reaction of the digestive glands, and the stomach was strictly affected by the animal's liking of, or aversion to the particular aliment.

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* J. P. Pavlov : *Le Travail des Glandes digestives*, p. 69.

† S. Jankelewitch : *Op cit.* p. 26.

The psychological aspect of these operations, M. Pavlov tells us, appears to be more certainly established than the physiological, and it is impossible to question the position that the living being contains within it a force distinct from physico-chemical agencies. It is this interior power of self-regulation which secures the proper working of all the organs, so far as they depend upon the individual, for these organs are connected with each other and are subordinate to the vital needs of the entire organism.

It would be futile to urge that we can maintain life in a kidney or heart after separation from the body ; this fact does not in the least invalidate a force that presides over all vital phenomena in the same individual, nor does it imply the parcelling out of this force in every organ. If we can in fact, for a given time, preserve a part of the body from the ordinary law of mortality, through the application of a particular temperature, or some antiseptic drug, etc., there is nothing to hinder these already organized elements from entering again, by a new disposition, into the cycle of vital operations.

Instability is, as we have seen, one of the characteristics of the organized molecule ; at every moment the living creature undergoes losses which it must repair ; its material identity is purely factitious ; to conserve its existence it regains on the one hand what it loses on the other, and this is what makes life so difficult to define. From its birth the living creature manifests an effort to maintain itself in equilibrium in the midst of the exterior forces that constantly oppose it. The nature of the ascending or descending curve, while showing the struggle of the opposing forces, registers the result of the effort of the living organism; the states of health or sickness are allied to these reactions, and it is almost needless to add that in the latter case one may expect everything from the vital force of the organism and from the psychic side. This is another essential point which mechanism fails to note.

We could also urge a whole assemblage of equally inexplicable facts which would prove not only that the organism acts on a clearly defined plan, but also that it is able to modify it in some degree, i.e., to adapt it to the needs imposed by the ever-changing external environment.

Everyone knows that the frog species repair without difficulty serious losses in their organism.

"The tail, the legs, even the eyes of tritons grow again almost as often as they are removed. I have seen," adds M. Delbœuf, whom we quote, "a young axolotl, five centimtères in length, which I carefully reared, repair terrible losses. I had him from his babyhood, and fed him for a long time on spruge-laurels; he throve visibly. One day I caught a chub, and had the unlucky idea of giving it as a companion to the Mexican salamander. What a painful surprise I had the next morning! There was nothing left on the salamander but its head, one claw, and half the body; the whole hinder part—tail, hind claws and the other front claw had been devoured by the ferocious chub. I will not say that my axolotl was none the worse; but it is certain that after some months his body was completely repaired and no trace of the accident was to be seen." *

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To anyone who knows the number of bones in the limb of a salamander and the complicated arrangement of all these parts which grow again, identically

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* J. Delbœuf: *La Matière brute et la Matière vivante*, p. 122. (F. Alcan, Paris).

as before, this fact will appear simply marvellous, and mechanism cannot explain it. All the phenomena of instinct, all the facts of mimetism, condemn the old hypothesis of Descartes, which considered animals to be mere machines, as automata similar to those which man can construct.

Modern Physiology, as we have seen, takes another view. All experiments prove the mechanist standpoint inadequate ; it does not, and never will, resolve the problem of Life, since we already are aware of facts completely inconsistent with it.

It would be superfluous, for our purpose, to advance a general theory of the living being in relation to the various and multiplied organisms which exist in nature. From this whole discussion we deduct only these two points :

Every living creature implies a Force distinct from Matter, a Force unextended, simple, invisible.

We cannot see this Force but every day we ascertain its effects, and, so far as our purely scientific deductions go, it is the same Force which acts on the material part of the living being to organize it, to guide it according to a plan laid down beforehand, to maintain it in equilibrium in the midst of exterior physico-chemical forces, and to preserve it from their action as long as possible.

Where is this Force located ? In our Space or in another ? How does it act on Matter ? Who has assigned to it the course it has to follow and the plan which it displays every moment before our eyes ?

Such questions we shall approach in the following chapters, after we have elucidated that of the human soul—the question that is to us of the highest and most fundamental interest.

CHAPTER XI

THE SOUL

THE existence of a certain "Myself" is doubted only by those who deny evidence.

For idealists "Myself" is the true and sole reality, their system, as we have shown, is quite wrong, but we have not to oppose them in this particular point. The material or positivist objection is more serious; for those who only admit the exstence of Matter, a spiritual self could not exist, and in fact they deny that it does in our sense.

There exist, they tell us, sensations which, added successively to each other during a man's life give him the impression of continuity: but the idea of a personal self is a mere illusion. Sensation and thought are Matter, nothing but Matter. But material substance is essentially multiple and discontinuous, which sensation is not. * The objection is really final; it has not escaped the notice of the modern positivists, and we will see how they have tried to turn the difficulty.

"There exist in nature only material phenomena," they assert, "but we look at them now from outside, now from within; in the latter case we call them sensations, states of consciousness."

"On the other hand, it is clear that all the sensations spread over the Universe cannot directly affect us, only those most intimately connected with

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* That is, when considered subjectively within ourselves.

our cerebral substance; and as in the experiment of Savart's cog-wheel one cog would not convey a sound to us, so it requires a great number of sensations to produce the *phenomenon* of sensation."

To sum up: according to this theory every sensation should be regarded as a total of minute elements of consciousness, too faint to be perceived separately, and it is by a kind of totalisation, or physical synthesis, that they unite and give us the illusion of Myself.

Such, presented in its most lucid and specious form, is the principal argument of those who see nothing in the world but matter. Such reasoning of course destroys all belief in the human soul as a spiritual entity.

If indeed every molecule of my brain is a centre of thoughts, a material phenomena seen from within, if all these minute thought-sensations unite to give me the illusion that I exist, distinct from all material particles, my soul is an idle hypothesis, and the advance of science will finally eliminate from reality this mysterious entity invented by ignorant people.

The objection here presented scientifically we find in a vague way possessing "the man in the street," he cannot express it precisely, but this is what he is apt, practically, to think:

"Since I see nothing beyond material bodies, since my own body is but matter, a combination of elements destined to perish, since it is my body that feels physical pain, and since all my thoughts, according to the text-books of physiology given to our students, are nothing but transformed sensations, the soul—which I do not see—cannot exist; when my body is dissolved, nothing will be left but dispersed particles of matter. Death is therefore the end of all."

Physical science, as we have seen, at the present moment shows up Materialism in a most unfavourable light. Mechanical motion is powerless to explain the construction of the Universe; and if we admit nothing but what we can see we shall never succeed in explaining anything whatever.

There are however forces which we do not see, which we never shall see, and it is even more than probable that many of them are not situated in our Space; such are the molecules of our body—they exist, but we cannot say to what Space they belong.

Further, were a whole series of forces located in a Space of four dimensions, we are certain that they must ever escape our direct investigation, being beyond the sphere of our sensibility, and utterly invisible, so long as our bodies retain their present constitution.

There remains a last hypothesis which we must consider, if it is not too absurd. Could we not conceive in the created world the existence of forces located in no sphere; in other words, is a place absolutely required for a Force or Substance?

If such a conception is not contradictory, it is possible, and we must record it for the benefit of all religions that teach the existence of Substances independently of the Matter of our Space, which cannot come within the range of our senses: God, pure spirits, good and bad angels.

A rigorous examination of the facts dealt with by Psychology will enable to approach all these problems usefully.

Multiple and complex phenomena occur within us, which we have so far designated under the general term *states of consciousness*; it is now time to be precise, and not to confuse under one name entirely different things.

Let us begin with the study of sensation. It is undoubtedly a purely interior phenomenon; no one denies that, though physiologists have described its exterior conditions.

For a primary sensation* to exist, an exciting cause is needed, coming from outside and transmitted to the brain by the nervous fibres.

Until we have further information, we will admit that there occurs in our body a sort of molecular disturbance, which propagates itself like heat in organic substances.†

By an always indentical path for a given sense, the vibration reaches a cell in the brain; there it produces phenomena, still mechanical, what we call *impressions*: then we *feel.*

Take an example. If you prick your hand with a needle what happens? A phenomenon similar to what happens if you throw down the first of a row of dominoes placed vertically at a little distance from one another; the whole row is shaken, and an instant later the last one will fall.

In the same way, the shock imparted to the extremity of the nerve touched by the point is transmitted with a calculable speed, and mechanically, step by step, to the opposite extremity. But here begins another phenomenon irreducible to molecular motion. As soon as the last cell is touched and vibrates in its turn, you feel nothing resembling a shock, but something which we call a *sensation* of pain.

Such, reduced to its greatest simplicity, is this mysterious phenomenon of sensation. We could discuss indefinitely the nature of the nervous influx, make it depend upon an unknown vital action; the course described will remain unchanged in its main lines, whether the nervous extremity first affected be called optical, acoustic, or olfactory; in every case there will be a mechanical excitation at the base, and on arrival at the other extremity the vibration of a cell, then, finally, sensation.

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* We say *primary* sensation, since in the phenomena of memory and hallucination the sensation still exists, but does not correspond to any external object; the phenomenon works the wrong way, and it may happen that the secondary sensation is objective.

† The study of the nervous current shows, in fact, that we know nothing of the mechanism of sensation. Perhaps it cannot be represented mechanically, but the following demonstration loses nothing of its value.

I ask once more, how could two facts so dissimilar be reduced to a common measure? We shall be told that the one is a mechanical phenomenon which we see from without; the other a psychological phenomenon, not essentially different from the first, but seen from inside.

Very well; but we cannot pay our debts with words; that kind of money is not current, as we have so often seen, in the Kingdom of Metaphysics.

To consider a cell a "physiological entity" is quite legitimate; but it is equally so to penetrate more deeply into the question.

For the chemist a cell is an extremely complex being, an individuality composed of a great number of atoms, and since every atom is itself a compound, we shall not pass the limits of probability in admitting that every cell contains some billions of distinct corpuscles.

From the standpoint of molecular Physics, no distinction exists between the protoplasm and the cell nucleus. The whole may be compared to an army of which the soldiers are disposed in groups more or less compact, or rather to a stellar cluster formed of myriads of suns round which revolve distinct planets.

Now to what element are we to relate sensation, this famous phenomenon which we perceive psychologically, that is to say backwards, according to the positive doctrine? The sensation appears to be simple, while the receiver is multiple.

The question is badly expressed, the champions of illusion will reply: all the elements feel at the same time, and all these minute states of consciousness—

i.e. sensations—group themselves so as to make you believe that they are one: but this unity is merely factitious.

Let us admit that for a moment; each of these billions of particles will then experience its modification under the form of an interior phenomenon, and all these elements will group themselves together in order to achieve one whole.

But then you must explain the mechanism of such an operation. Each particle is distinct from its neighbour; from the spatial point of view we have seen that it may be in relation to those surrounding it, but of what kind is the communication between them? We do not know; in any case we are certain that the forces of one do not pass into those of another.

We are reminded, however, that the modification of one of the particles produces that of its neighbour, and so on. That is beyond doubt, but if the modification, we repeat, affects the first and calls forth a modification in the second, the two modifications *do not change places*. The state of each remains quite distinct: nothing which belongs to the first subject passes into the second. Since no particle goes out of itself or transfers anything to its neighbour, the famous sensitive phenomenon, which is the point under discussion, could not form a united whole. It is no use for us to think that *we*, by contact with our our neighbours, could form a united whole of all *our* pains and *our* sensations. And this illustration is quite inadequate; we should rather compare the sum of our sensitive particles to a thousand million solar systems, with their planets revolving round centres placed, in relation to their size, at enormous distances.

As to the mechanism of "totalised sensations," we might as well try to grasp, by the medium of ether, the sensations of the possible inhabitants of the various planets of our system "totalised" with those of the hypothetical beings who inhabit the worlds that revolve round the far-off suns of the Milky Way.

Thus to "totalise" sensations, which are essentially simple and indivisible, to produce one resulting sensation, is really to express a proposition which contains nothing but words without any meaning.

On the whole, I would a hundred times prefer the old physiological theory, according to which all the nervous centres end in a *sensorium commune*, a kind of receptacle for all our impressions; yet even the philosophers of the period when this theory was held saw that it did not elucidate the problem but merely put the difficulty further back.

Since the sensation requires a subject to receive it, and since this subject cannot be conceived as formed of various parts it must be indivisible. Now there is no middle term between the multiple and the simple; the subject of the sensation is therefore necessarily simple. And since, moreover, the sensation varies, either in kind or intensity, we are obliged to consider it as an accident—and an accident supposes a substance.

There are therefore substances able to perceive their own modifications, and being simple these substances are unextended.

If then by our hypothesis each cell is in connection with a nerve-termination which receives the impression, we must admit at that receiving-station the existence of a simple unextended substance, of a real conscious force that perceives the vibratory condition peculiar to each cell, a condition determined by external actions.

This simple, conscious, unextended force is what psychologists call the *Soul*; we should then have as many souls as cells, and the problem appears in the same terms as before. We have not made a step forward, and now we must imagine a new soul centralizing the sensations of the first various souls, in order to explain that we have the very real faculty of perceiving and centralizing all sensations by referring them to the same subject.

For this reason Descartes, discarding as absurd this notion of multiple souls in the brain, had the idea that the soul, simple, unextended, and indivisible, is confined in a limited portion of the encephalic matter: the pineal gland.

But Physiology has not agreed with the famous philosopher, and we now know that the sensitive nerves meet neither in the pineal gland nor at any other common point.

There is, properly speaking, no special receptacle; the terminations of the sensitive, as well as of the motor, nerves are distributed through the whole of the cerebral mass, and though each sense or organ possesses receivers separately located, it seems very probable that ways of communication unite them, a kind of telegraphic system that sets multiple wires in motion, each making its appeal, so soon as one sensitive apparatus is affected.

Now we must consider it as a fact proved by experience that we are aware of a sensation, whatever portion of the cerebral matter may be affected. Objectively, that is to say outside of myself, or even in my body inasmuch as it is material, when a vibration takes place the cells resound in unison with the exterior, like the chords of a piano, and at once, if the instrument is in good condition, I am conscious of a sensation. Now, whatever be the particular point affected in my brain, the sensation is communicated to the same subject, *i.e. Myself*; the soul is therefore at the same time in contact with each sensitive centre—a phenomenon to which material substance has not accustomed us.

The number of relations which a material particle can possess with other particles of the same nature is extremely limited. Action at a distance does not exist; to enter into relation with, *i.e.*, to exercise its action on, a multiplicity of objects, a material particle must change its place, and we say then that there is motion, which involves a concatenation of causes and effects: consequently, *succession.*

This is not what the soul does in the act of sensation, since our consciousness can enter into *simultaneous* relations with many cerebral cells materially distinct from each other.

We can smell a perfume, hear the symphony of an orchestra, distinguish the instruments and the musicians, beat time with our foot, chase away a fly that teases us, all at the same time; we can experience the corresponding sensations, can *centralise* them, although the impressions are dispersed over the cerebral matter; and, once more, all this cannot take place except through the extraordinary power which my soul possesses to enter simultaneously—and not successively—into contact with particles of matter spread over a wide extent.

Such a Force, which can exert its action contrary to the laws of our Space and our material Mechanics, a Force totally unlike material energy necessarily involves a different nature; such a principle we call *immaterial.*

This distinction between the immaterial and the material, which is the necessary result of the analysis of the phenomena of the Universe, which is rooted in the essence of the substances accessible to our understanding, is the reef against which all monist philosophies, with whatever names they deck themselves, must strike.

And now, before we continue the enumeration of the prerogatives which the human soul enjoys, let us glance at the sum of the energies which the study of nature reveals. A marvellous plan is unrolled before us.

At the lowest stage of Being is Matter subject to the laws of Space and Time. The natural philosopher endeavoured to endow the ultimate material particle with an incomprehensible property—*inertia*; a purely negative quality which the disregard of Scholastic Philosophy imposed as a scientific dogma, quite intangible.

Unwillingly, perhaps unconsciously, the new Physics have returned to the immortal teaching of Albert the Great and St. Thomas.

Being is essentially active; all activity involves change, *i.e.*, motion; every motion requires a starting-point—an origin—and an aim, a term to which it tends. The characteristic of Matter, of Being in its lowest state of activity, is therefore not essential impotence or negation of all activity, but the fact that this activity, tending towards a determined end, will never change its direction of itself; it goes to its end by the simplest means, we might say by the shortest way; in a word, inorganic nature, always and everywhere, acts according to "the principle of the least action."

Why? Who has imposed such a law on Matter? Certainly not you or I, and to say "it is a law of Nature" is to give no answer at all, since of itself it performs such a feat which fills the most learned men of science with admiration, but which at the same time puzzles and irritates them.

Let us listen to Mons. H. Poincaré on this point:

"The mere statement of the principle of least action offends the mind. A material molecule, in order to pass from one point to another, exempt from the action of any force, but compelled to move on a surface will take the geodetical line, *i.e.* the shortest route. It seems to know the desired point, to foresee the time it will take to reach it by following such or such a way, and then to choose the most convenient. The statement gives the idea of its being animated and free. Obviously it would be better to substitute another that offends one less, and which, as the philosophers would express it, would not seem to put final causes in the place of efficient causes."*

Why does such a statement offend certain minds?
Clearly, because we must choose between two
1- explanations : either to endow Matter with profound
consciousness and true freedom, which is grotesque ;
or to affirm that a Supreme Power has arranged all
2- according to a definite design, imposing laws on
creation in view of an end to be reached ; that is
Science itself leading us to God in the most unexpected way.

No, the material molecule is not free, nor animated, nor intelligent, but it is bound by necessity ; it acts as it does, because an Intelligence has thought for it and imposed His will upon it.

When God had created the Matter of which the Universe is made, when He had animated it with the vibrations of ether, and when after all condensation the *dry land* appeared, "God," Moses tells us, "saw that it was good"—that is, in accordance with His will ; Matter obeyed, tended towards its aim, which consists in stable equilibrium by the law of the least action.

Optical mechanics, molecular activity, thermodynamics, all these are part of the grand scheme in which the harmonies of Providence are displayed before the eyes of the analyist who knows how to see.

But the wonderful laws which govern Matter perhaps nowhere appear more marvellous than in the mysterious world of the atom.

In uniting themselves to form crystals, the ultimate particles of Matter display an ingenuity which more than one scientist might envy. Each atom makes use of everything within its reach to realize the maximum of stability and to resist destruction. Such a crystal, too fragile to maintain itself in the shape assumed, as that of the Christianite for example, begins by grouping several individuals: columns gather together at right angles in the three dimensions of Space; the solidity is still insufficient; to strengthen the interior angles our columns thicken, solder their extremities, and soon the whole structure takes the form of a twelve-sided solid. We find the same mechanism in the diamond, which acts as if it was conscious of its fragility.

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* H. Poincaré : *La Science et l'Hypothèse*, p. 154. (Flammarion, Paris).

And these are not isolated cases; all crystal groupings are subject to similar rules. In this inorganic kingdom, where the microscope reveals facts that disconcert the positivist, it often happens that the individual particles help each other: one may meet with associations of the most heterogeneous substances, but always to the better securing of the forms which may be termed "best."

"If such clever combinations," says Mons. A. de Lapparent, "instead of taking place in the mineral world, were to be found, like the facts of mimetism, in the organic kingdom, there would no doubt be followers of Darwin who would find the explanation in the law of the survival of the fittest, transmitting by heredity the qualities which have gained them the victory. But here, where we are dealing with crystals, who could talk of instinct, or survival, or heredity? How then can we refuse to see in this the intervention of that Law-giver, Who secures to each species the best conditions of resistance by the 'principle of the least action,' and even permits each to acquire, through the wonderful adaptability with which it is endowed, a much greater stability than its proper nature appears to allow."*

Let us make a step forward and cross another boundary: here appears a life of which the mineral existence gave but a feeble image. New forces have arisen, invisible no doubt to human sight, but none the less real. In the vegetable world the individuality becomes clearer, a special energy takes possession of Matter, transforms it into another substance, delivers it from the laws of inorganic matter, raises it in the scale of being. There also we shall ascertain the existence of a direction, of a tendency, of means wonderfully adapted to an end. Unity is evident beyond dispute, but how fragile is the structure; if each individual struggles for life, it is chiefly for the preservation of the species. The individual matters but little, since it possesses the faculty of perpetuating itself in its descendants.

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* A. de Lapparent: *Science et Apologétique*, p. 154. Conf. de 1905. (Bloud et Cie, Paris).

The Newtonian attraction no longer works here, but by wise manœuvres the seed attracts the pollen, the germs multiply, and Nature exhausts herself in a vast and unlimited prodigality: a marvellous instinct, the precursor of wonders still more sublime.

"And the earth brought forth the green herb, and such as yieldeth seed according to its kind, and the tree that beareth fruit, having seed each one according to its kind. And God saw that it was good."*

From the simple organic cell to the most highly organised vegetable, it seems that an immaterial principle rules the life, which strives to shelter the material substance from the physico-chemical forces around it, which directs that same matter to the end marked out for it by the Creator; but these are, as it were, but the first stammerings of a new force, of a realised antinomy in the material substance.

The plant struggles in a medium which comes to it, which nature imposes on it; its reactions are therefore necessarily limited. Altogether different is the animal, which now appears on the scene.

The internal force which directs it is capable of a certain knowledge, of an inferior kind no doubt, but enough to allow it to attain its end by the most various means. In the centre of its being Nature reflects the beauty of her forms, the enchantment of her infinitely varied splendours.

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* Genesis i. 12.

These mobile creatures with their manifold forms, these sensitive organisms which an extraordinary flexibility accommodates to all surroundings, whither are they going? What do they seek? They do not know. There is no need for them to inquire what their aim may be. Has not God endowed them with that mysterious force of instinct, a thousand times more able than our most refined intelligence?

Read again the suggestive pages of our most recent entomologists, and you will be literally stupefied. The insect recites a lesson it has learned; and that lesson, though it does not know its meaning, it transmits to its posterity without omitting a single phrase.

God had said: "Let the earth bring forth the living creature in its kind," and it was so, and God saw that it was good, for all, plants and animals, have obeyed the divine law, which is the Truth, all have gone without pause along the appointed road, and that is why, although they know not God, nor His divine designs as they go towards their final aim, they have praised the Lord Almighty, the Creator of heaven and earth, as Daniel tells us in one of the most wonderful canticles in the Bible:*

"O ye heavens, bless the Lord: praise and exalt Him above all for ever.

O all ye things that spring up in the earth, bless the Lord: praise and exalt Him above all for ever.

O ye whales, and all that move in the waters, bless the Lord: praise and exalt Him above all for ever.

O all ye fowls of the air, bless the Lord: praise and exalt Him above all for ever.

O all ye beasts and cattle, bless the Lord: praise and exalt Him above all for ever."

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* Daniel iii. 59, 76, 79, 80, 81.

CHAPTER XII

WHY OUR SOUL CANNOT DIE

THUS, to sum up the conclusions we reached in the last chapter, we can affirm that every sensation requires a simple subject, *i.e.* a subject not composed of parts, like extended or material bodies, but possessing an essential, not a factitious, unity.

None the less, the operations of such a subject are connected with Matter. There is no sensation apart from a physiological mechanism, without the production of a movement in the brain; even in the phenomenon of memory there is the recall of an experienced sensation; the physiological image, though not corresponding to any present external phenomenon, exists none the less in the cerebral cells under a material form; that is beyond doubt, as all Physiology proves.

Whence it follows logically, without desiring to enter into the disputes of the various schools, we are entitled to ask if such a subject, thus depending upon Matter for its operations, can subsist without it and apart from it; that is, if it is a Substance.

Since I feel, I have a soul; that is agreed; but I have at the same time a material body: the human *Myself* is therefore composed of two things, and yet I am conscious that these two are so closely united that I am one subject, and from this alliance, which closely resembles what chemists call a combination, results the *Self* of which I have an extremely clear conception.

Now, if the exercise of the sensitive faculty implies an operation common to body and soul, I must ask what will happen, in relation to this fact, at the moment of death.

Without laying down any postulate as to the mechanism of this union, or more correctly this fusion, of soul and body, experience tells me that the material particles of my body are agglomerated only for a moment. To-day they are under the control of my soul; to-morrow they will re-enter the whole mass of material forces that compose the Universe, and be scattered to the four winds of heaven. And what will the soul become? If its nature is merely sensitive, *i.e.* if sensation alone is its object and its end, it is evident that it would no longer have the power to act.

From the moment of my death, my soul losing all contact with my body, unable to animate and guide it, since it exists no longer and its particles are dispersed, all sensitive consciousness must vanish; the energy of my soul will be entirely unavailable, its condition negative and incomprehensible.

Some philosophers will insist that since the soul is immaterial, simple, and indivisible, it cannot be annihilated. To this we may answer that it matters little to us whether that is the case, if consciousness and memory vanish, if the principle of perception perceives no longer and feels neither pleasure nor pain, if nothing really exists any more for it, and if, an unconscious particle of the Universe, it merely adds one more to the myriads of electrons that compose matter. If such were the case, would not the most suitable definition of the soul be that which we have given of the material particle—an unconscious support of energy, a simple fragment of ether?

In such a theory there remains a vast field for hypothesis, the principles on which it is based are extremely questionable; the philosophy of Spirit must offer us something better than that.

All difficulty would, in fact, disappear if we could prove that the human soul, though intimately united to the body, does not depend on it for existence, in order to live its own life, *i.e.* in order to be a true Substance. In order to do this, it will be enough to analyse certain phenomena which are joined to our sensations and go so far beyond them that it is impossible to reduce both to a common measure.

Our soul is not only capable of feeling, but of thinking also; a distinction upon which philosophers could never insist sufficiently; let us try to define it.

To feel is to receive an impression, to be affected by a cause. *To think* is to compare, to judge, to generalise.

Let us take some examples. Here is a rose and a pink; you smell them one after the other. The odour of the one is not that of the other; the two flowers produce two effects on you, which you do not confuse. You perceive the difference? Perfectly. Now when you say that you state the result of an act which I defy you to reduce to sensation.

If you insist on saying that this act which I qualify as judgment is in fact only a sensation, I ask you *which* sensation—the perfume of the rose or the pink? Neither, because to compare you need two terms. If you say, on the contrary, that the perception is that of the two scents simultaneously, you have only a resulting sensation; and also you will distinguish the two scents simultaneously. If you think that they are really one, you have but a single sensation, and the question remains where we began.

It is impossible therefore to reduce the perception of a distinction to the phenomenon of a sensation.

To judge, or to compare, certainly combines the two, but it is a fresh act which cannot be confounded with them.

Another example. What is a triangle? You will answer that it is a figure enclosed within three intersecting straight lines.

By what sensations have you arrived at this definition? Study the words of it, and you will see that every one of them is the result of a determined and concrete sensation; but this is not the case with the idea you attach to it.

How, for instance, have you conceived the idea of a straight line? You have seen a thread, or a ruler, but you know these are not straight lines. A line has neither breadth nor thickness: two further notions, which you have been obliged to *abstract* from the mere sensation. By what sensible perception could you arrive at this extraordinary and essentially abstract thing—a thing without breadth or thickness—the straight line? You have never met with straight lines in Nature; by what faculty can you conceive an entity which does not exist?

When the geometrician traces figures, he knows quite well that they are inaccurate; it is impossible to represent graphically the idea of a circumference, of a polygon, of a right angle, and yet we reason about these figures, and these reasonings express truths, relations of metrical order, available at least for our Space, and grounded on reason. All Geometry is based on abstract ideas, not on concrete sensations.

The *idea* is then the product of a particular action of my mind, exercising itself, by means of a special faculty, on sensible data. Objects only give us particular sensations, perceived to be such as they are by our sensibility.

The faculty of *generalising* is absolutely different: without it, it is impossible to grasp the ideas of being, of cause, of effect, of succession, of infinity. All these transcendental notions could obviously be *called forth* by means of a sensation, but not one could ever be *imagined*; they contain something beyond the reach of our senses; since therefore I conceive them and distinguish them from what is not themselves, these notions have been bestowed on me by another faculty than that of sensation. And name this faculty how you will, it will exist none the less.

It is impossible to conceive of language without reasoning and thought: all our verbs express relations of universal order, i.e. applicable to any subject.

Here is another marvel which cannot be explained by sensation: my soul possesses the faculty of perceiving itself: when I say "I," *I think of myself*. Analyse this simple phrase, and you will agree that here is a baffling, though real, mental act, which forces itself on me with evidence that is beyond all question. It is an act which expresses the fact that the subject and the object of the verb are one and the same thing; such an act is termed *immanent*, i.e. it remains in the subject, which is *at the same time* cause and effect. The soul is the cause, the thought is the effect, the modification produced by the soul by which it conceives itself, which is, as philosophers express it, a sort of intuition of itself.*

Similarly, the soul apprehends another faculty in itself: the Will. When "I *will* this, and not that," I feel that my soul exercises a faculty that has nothing to do with sensation. I will, for instance, some pleasure; this latter, I do not deny, can be a sensation, but the act is quite a different thing.

Consequently, phenomena of *understanding* exist, in so far as the intelligence perceives the universal, exercises its action upon ideas, comprehends itself, realises itself: while phenomena of *will* are perceived intuitively by the soul, with regard to acts which do not depend on sensations, which even go beyond

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*We say "a sort of intuition" to make the meaning clearer. *Pure intuition* of our soul could not exist in this life. We are conscious of our soul, but we do not see it; similarly, we arrive at the knowledge of God by His works, but we do not see Him, we have no intuition (*intueri*, to behold) of Him. On the contrary, we have intuition of sensible objects, and intuition of certain phenomena of intelligence and will.

them, which have no common measure with perception and sensible intuition, which consequently, by reason of their nature, do not need the action of the body.

If then these operations are proper to the soul, as far as it is immaterial, the soul does not require Matter in order to perform them; it can act without, and does not depend upon, Matter; it can exist by itself, and is consequently a Substance. And that is what we had to demonstrate.

The dissolution of the body ought not then to influence the soul; at death the soul, though separated from the body, persists in its own existence; no created force could annihilate it, any more than a created force could annihilate a particle of Matter; whence we must conclude that the human soul is immortal.

Thus, this privilege of immortality, of persistence after its separation from the body, is owing, let us mark well, not to the fact that the soul is merely immaterial, but to the fact that it is a Substance, that it can exist by itself. It is endowed not only with the faculty of sensation, but also with those of thought and will. Such a Substance goes far beyond the immaterial and is termed *spiritual*.

This distinction was altogether necessary in order to define the meaning of the words.* And yet in this life the soul does not exist as pure spirit, but as a spirit united to Matter; Spirit and Matter so interpenetrate each other as to produce the human compound in which Matter, raised to the degree of Life, receives its principle of Life from the Spirit that animates it.

The essence of the soul is not then what most people think it to be, repeating an old doctrine of Descartes who did not, we may remark in passing, see altogether clearly on all these questions.

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* Cf. on this question: Balmès, *Phil. Fond.* (Book II. Chap. ii. No. 15.)

The soul is not bound to exercise all its faculties at once, it can not only think, but also feel and will. It can even sometimes exercise none of them, but it exists none the less, without our being conscious of it, as the animating principle of the body to which it is united.

Even when all our intellectual faculties are in abeyance, the soul is there, watching unceasingly over the body. Even in the case of the insane and feeble-minded the soul which animates the body forbids us to affirm that these are not human.

Some anti-materialistic philosophers, while accepting the definition : "Man is an intelligence served by organs," altogether ignore one side of the question, and so disregard, belittle, and misinterpret human nature. The vital act depends on both soul and body ; the same is true of sensations and certain sensible volitions which we have in common with animals. This doctrine is the only one that explains why the soul has need of the senses, and consequently of the body, for thought, although thought is essentially a spiritual faculty.

Let us recall what thought (or the *idea*, if you prefer the word) really is. When the soul thinks, it does so only on concrete materials, on images supplied by objects. But an object is always determined ; it is a rough fact. The *idea* penetrates beyond this, and extracts the general from the particular ; it seeks the causes hidden behind the phenomena, perceives the substance hidden beneath the accidents, the very essence of Being. It is only there, starting from that halting-place, that it can get free from sensation and Matter.

When the soul reasons, issues judgments, forms comparisons, in short, handles universal ideas, it has no need for matter. You do not confuse four thousand millions of vibrations of ether with a sensation ; do not, therefore, imitate those physiologists who cudgel their brains to make us understand how a thousand separate sensations go to form one universal idea. One must never have reflected, nor analysed, to express such absurdities.

A mechanical vibration is one thing, a sensation another, an idea yet another. You will now understand more clearly the folly and ignorance certain physiologists display when they come and tell us that our intelligence is located in the frontal part of the cerebral lobes; one might as reasonably say that I think with my penholder or my inkstand. And yet so great is human folly that one finds such assertions in many text-books of Physiology put into the hands of our students, and you can even find educated men who believe them.

But for mercy's sake, examine, go to the heart of things; if our religious dogmas rested on such assertions, such monstrous imaginations, you may be sure that long ago the Church would have ceased to retain an intelligent person within her bosom.

As a rule, also, in studying a science, one should not be content with primary, or even secondary, manuals; in most cases one would run the risk of finding the science badly popularized, and that at second hand; their authors have not hesitated, in order to oblige a publisher, sometimes merely to make money, to undertake different series of such handbooks. The author of a book on Cosmography, who has not studied modern Astronomy, does not hesitate to deal with Physiology in the same manner. During my career as professor I have often been obliged to place obviously incorrect manuals in my pupils' hands. In such books, Anatomy and Physiology specially received this off-hand treatment. That is why it is necessary to go to the fountain-head.

On the precise point we are considering—the localisation of intelligence—it is very rare to find in the great treatises on Physiology the assertions scattered shamelessly through "popular" manuals. In these treatises you will find that the localisation of the intelligence in the frontal lobes is a fact which has never been demonstrated.

"The intelligence," says M. Munk, "has its centre everywhere in the cerebral system, and nowhere in particular." To be sure, after the brain cells have worked, it is the turn of the outer cells to be put in motion, and this motion is the necessary condition of the functioning of the intelligence; but that does not allow us to conclude that intelligence is an organic faculty.

hsig Again, when ~~Fleshig~~, in his discussion on the functions of the outer zone, inclines to the belief that there reside the centres of association, he only puts it forth as a hypothesis and says conditionally: "There might be here the intellectual centres and the veritable organs of thought."

To which M. Gley, the famous physiologist, professor at the Collège de France and at the Faculty of Medicine of Paris, replies: "There is some exaggeration here, for it is almost certain that we think with our whole brain; the suppression of one or more centres of projections more or less hinders the exercise of thought. It is, however, probable that the power of control which chiefly characterises intelligence and will, resides in parts of the brain distinct from the sensible centres."

chsig Even according to Fleshig, one must distinguish between the outer cerebral regions; there are what he calls primordial and backward territories. Impressions from outside cross the first before they reach the second, and it is only when they have been myelinished—that is, innervated—that intelligence and will come into play.

"Thus," adds M. Gley, "the old aphorism is justified: *Nihil est in intellectu quod prius non fuerat in sensu.* The brain of an infant is, to begin with, like a blank sheet, on which sensible impressions are gradually written, which only later on will form [*furnish* would be more exact] the material of the various intellectual operations. In this sense one might say that the physiology of the brain is Aristotelian." *

Thus our spiritual conceptions, far from being invalidated by Science, are on the contrary wonderfully confirmed by it.

Let no one then teach henceforward, in the name of science, that the frontal lobes are the seat of intelligence or thought; no, man thinks with his whole brain, he needs all the cerebral centres to provide him with the material which his intelligence will utilise. Such is the true formula laid down and accepted by all who do not desire to transgress the limits imposed on Science.

Metaphysics, however, can go further, and we naturally proceed to ask: *Where* is the soul? an obviously interesting question, but one which involves a crowd of other problems.

First of all, is it necessary that everything that exists should occupy a place? Not in the least. Suppose that God had created one solitary being, simple and indivisible, where would this being exist? Nowhere, evidently; or rather, the question having no meaning does not admit of any answer.

The concept of *being* does not at all imply the concept of *place*. Extent, we have seen, implies multiplicity and inter-relations. In the supposed case there is no multiplicity, because the being is, by hypothesis, solitary; and no inter-relations, since these imply intercourse, which could not exist where there was only one.

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* E. Gley: *Physiologie*, p. 1057. (J. B. Baillière et Fils, Paris 1910). To show more clearly the analogy between the Aristotelian doctrine and the conclusions of modern Physiology, we should compare with M. Gley's phrase the following passage of Balmès: "The starting-point in the Schools was this principle of Aristotle: *Nihil est in intellectu quod prius non fuerit in sensu.* Whence it follows that before receiving sensible impressions the soul is *sicut tabula rasa in qua nihil est scriptum;* or as we should express it now-a-days, like a blank sheet,

Let us notice, besides, that if either multiplicity or relation is lacking, the question of Space does not arise. Space in itself is nothing; consequently if simple beings of material nature existed at the same time without any intercourse, they would not be in any place. Similarly, ought we to say that a spirit can exist in our Space? Let us understand each other clearly.

From the standpoint of Space a Force *is* where it *acts*: this, which we have already admitted, is what has given us the notions of *place* and *contact*.

In the Universe, when one molecule acts upon another, or on two, three or four material particles at the same moment, we say that these molecules are in direct contact; but experience proves that the action of such a molecule is extremely limited. Why? I do not know; it is because God has so willed, and imposed such a law; but we have seen that no spatial law is necessary, all such laws are contingent, since we see no radical impossibility of their being otherwise.

We speak of an experimental fact being verified for the rough groups of material particles, although we have demonstrated the probability that our conclusion is no longer a fact when we come to the ultimate particles which suggest a Space of four dimensions. Experimentally, however, we admit that when one force acts upon another only through intermediate agents, they are not in contact. To sum up, therefore: *Contact* only signifies *direct action*; *Distance* signifies *indirect action.*

Let us explain these propositions, and we shall arrive once more at the conclusion that a Force *is* only where it *acts.* But, on the other hand, since I know that the relations of Extent—*i.e.* the relations between substances—could be otherwise than they are, I couclude that a Force could act upon neighbouring forces—and it does that, since this is why they are called "neighbouring"; and upon distant forces, since these are "distant" only because the first force has to reach them indirectly.

If then we suppose a force to extend its activity, that is, to multiply its relations, we are obliged to acknowledge that it is in many places at once.

It is in this sense that the Catechism teaches us that "God is everywhere." This does not mean that God is extended in Space; a simple Being has no parts (no extension). But if we admit that every being *is* where it *acts*, it is clear that God, Who has given existence to all things, and acts at the same time on all the forces of the Universe, is in all places simultaneously.

This question has been dealt with by St. Thomas with the hand of a master: "God is in all things by giving them being, force, and power of action. He is in all places, sustaining all creation * . . ." and he adds: "Incorporeal things do not occupy a place by contact, in so far as they can be estimated, but by *contact of activity* (*virtutis*)." †

Let us now return to our original problem: Where is the soul? We have all the elements for its solution. The soul, being spirit, is not, properly speaking, in a place; to attempt to localise it in the brain is philosophically meaningless; that for certain acts it makes use of the brain as a necessary organ, I would not deny; but there is no more reason why it should not extend to the nerves, since if the nerves act, it is under the influence of the life which depends upon the soul. And then, if there is no part of the body without nerves, we are compelled to spread the soul over the whole body.

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* Summa, lib. I. Qu. 8, a. 2.

† In Art. I (the same Quest.) St. Thomas writes: "Since God is The Being by His essence, the created being depends upon Him, as the effect upon the cause . . . This is so not only at the beginning of their existence, but so long as they continue in being . . . It is necessary, therefore, that so long as the thing created exists, God should be present in it according to the mode in which it possesses being. Being is the intimate essence of things, that which is most profoundly inherent in them, the real and proper substance of the created being; thus God is in all things, and after an intimate manner."

All these attempts to localise the soul are but childish dreams ; we must go back to principles at once more philosophical and more fruitful. We can say that the soul is in the body and every part of the body, though it is not in Space at all, and on account of its spiritual essence cannot be compelled to occupy a place ; but since it acts upon the whole body simultaneously and animates the whole of it, we can say that it is in our body by its action ; as we have seen God to be in the "contact of activity" with all created things.

Thus all difficulties vanish when we face these problems, not with our senses but our reason ; in our study of Hyperspace we must be on our guard against exploring these regions by means of our sensible data ; let us not be the dupes of our imagination, which makes God, the soul, and spiritual beings, appear under extended forms, subtile, cloudy, and aerial.*

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* On this point Balmès observes. "By 'to be in Space' we understand 'to be contained in Space.' St. Thomas does not admit this definition in relation to spiritual beings. If bodies, he says, are contained in things, spiritual beings, on the contrary, contain the things in which they are." Balmès, *Op. cit.* L. III. Ch. xxvii, p. 197. St. Thomas is obviously right. Cf. St. Thomas' *Treatise on the Soul*, Part I, Q. 76. a. 8. The soul is not *in contact*, except virtually, with the body ; this contact consists in the fact that the soul is the *form*, or principle of activity, of the body which it animates. V. Elie Blanc : *Traité de Phil. col.* No. 725. Cf. also the decree of the Lateran Council (1512-17) "anima est vere per se et essentialiter humani corporis forma." Council of Vienne (1317) ; Apostolic Letter of Pius IX to the Archbishop of Cologne (1857) ; and Zigliara : *De mente Concilii Vennensis.*

Let us always remember that the concept of Substance implies neither place, nor Space, nor relation, nor anything analogous.

If God were to suspend instantaneously the laws of the universe; for example, the active relations between the various material particles; the matter would exist, though its extension would disappear; quantity would remain though Space would vanish; every substance would persist in being with all its essential properties; every being would remain as isolated before the face of God; motion and change would have no more meaning, because all relation is suppressed; impenetrability itself would have no *raison d'être*; and Time, the measure of motion, would disappear.

With these transcendental conceptions of place and Space are connected questions of the highest interest from the religious standpoint.

It is on record that certain persons have been seen in more than one place at the same time; they possessed therefore what we call the gift of *ubiquity* or *bilocation*. Let us consider some instances in order to understand the whole bearing of these mysterious manifestations.

Sometimes it appears that only the soul of the subject had the privilege of being in "contact of activity" at a place far distant from the body; sometimes that the whole being—body as well as soul—was transported. Often the subject himself was unable to give the details of the miracle of which he had been the object. Thus St. Paul, when transported to heaven in his vision, could not describe what had happened: "I know such a man," the apostle is speaking of himself, "(whether in the body, or out of the body, I know not: God knoweth): that he was caught up into paradise, and heard secret words, which it is not granted to man to utter." *

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* 2 Cor. xii, 3. 4.

Sometimes there are phenomena of vision at a distance and undeniable communication, as one finds in certain episodes of the life of St. Benedict,[*] St. Mary Magdalen of Pazzi, and others.[†]

St. Catherine Ricci, while at Prato, saw and conversed with St. Philip Neri, who was in Rome.[§]

Maria d'Agréda, after the five hundred bilocations or similar phenomena which were proved to have occurred during her life, confessed that she could not affirm if there had been genuine bilocation. "I believe it is most probable," she said, "that what happened is, that an angel appeared in my form in this country, preached to and catechised the Indians, and that the Lord showed me here, in meditation, what had taken place."

"But," adds Dr. Surbled, writing on this question, "the theologians have come to the help of Maria d'Agréda, and have decided that some of these presences were not representative, but physical; they rely on the fact that several times she was conscious of surrounding bodies, and of the climatic variations of the distant places thus visited."[||]

Theoretically, we can perfectly well conceive of a soul acting in two places at once ("presence of activity"), and borrowing, by a divine effect, a body similar to the first. Besides, since by any hypothesis we must have recourse to a miracle, that is to a fact contrary to the natural law at present existing, one does not see why the corporeal presence could not be endowed with the same privilege, of occupying several places at once ("contact of activity" again).

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[*] Patr. Boll. Lib., iii, p. 579.

[†] *Ibid.* Lib. vi, p. 170.

[§] *Ibid.* Lib. ii, p. 506.

Dr. Surbled: *Les Phenomènes télépathiques (in La Science Catholique*, February, 1910*)*.

The concept of Substance does not in the least involve that of unique place. If in our Universe the two ideas seem in some way to depend on each other, that is because Substance is ruled by laws which postulate this inter-dependency, but our present conception of Geometry and of Space has shown us that all these laws are contingent; God can change them as He pleases *

It is in this way that St. Lidwina several times brought back from distant places which she visited, *while remaining at home*, news of accidents of which her body bore the trace, and which therefore proved her presence in both body and soul in those places.†

This seems the only explanation of other facts also. It is certain that St. Alphonsus de Liguori one day confessed several people in his house, while preaching in a neighbouring church. §

"The same saint, on September 21, 1774, fell into a quiet sleep which lasted until the next day, when suddenly he rang the bell. His servant ran in alarm to ask what had happened to him; for he had been two days without eating or speaking: 'That may be,' he replied, 'but do you not know that I was with the Pope, who has just died?' Some days later it became known that Clement XIV had died exactly on the day and at the hour when Alphonsus had called his attendants to tell them of the Pontiff's death." *

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* This explanation is also given by certain philosophers: "One does not see why the same body could not be absolutely speaking, in several places, if not locally, at least by its Substance, which by its nature is not limited to any place, and can enter into relation with all. And if the objection is made that a body cannot exist out of itself, we reply that it is not out of its own proper essence, and that it is in different places without being confined by any. These considerations enable us to gain some idea of the Real Presence of Jesus Christ in the Eucharist." Cf. Elie Blane: Trans. de Philosoph. Scholastique, nos. 678, 679.

† Acta SS. I. Chap. iv, 51, 52.

§ Patr. Boll. ix, p. 227.

St. Veroul one day interrupted his Mass for an hour, to the great astonishment of the congregation; his body remained there, and at the same time he was seen to rush into a house on fire where he rescued a child whom he restored to the parents. †

In the same way St. Anthony of Padua paused during a sermon he was preaching at Montpellier, and at the same moment his brethren saw him and heard him singing in their monastic church. § One could multiply such instances, which are found by hundreds in the lives of the Saints, but we must stop here.

Once more, all these facts could take place only by a change in the present laws that govern our spatial world, that is by a miracle; we shall never know the intimate mechanism of this phenomenon; but Metageometry, especially that of Hyperspace which we have studied, casts a new light on these extraordinary facts, and shows us that in themselves there is nothing absurd nor contrary to our reason.

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* *Ibid* vii., p. 223.

† Patr. Boll. vii, p. 227.

§ This fact is established by a mass of indisputable testimonies; it was renewed once at Limoges, in similar circumstances.

CHAPTER XIII

AFTER DEATH

THE soul being a simple and indivisible spiritual substance has no need of Matter for its existence. The decomposition of the body cannot therefore affect this ; the soul's life does not end with the dissolution of the human compound.

This we have demonstrated, but our thesis has given us no information whatever as to the conditions of the future life, on the lot which awaits our soul when no longer united to Matter. It is a tremendous problem, which has haunted all philosophers, all thinkers, all who have felt the void which death makes round about us.

And when the instinctive belief of the human race, in accordance with sound philosophy, claims for our soul the preogative of immortality, take special notice that the question is not merely to know whether the metaphysical principle of our soul will still exist ; what we long for fervently, what alone can satisfy our thirst for immortality, is the persistence of our personality, of the *Ego* that has thought, acted, and suffered here below, which has loved and willed, which has fought against its passions, has merited, and has perfected its moral life.

If we go down to the foundation of our being, if we analyse our deepest feelings, our most profound aspirations, that and nothing less, is what we desire.

We might here refer to the various systems offered to us by upholders of Metempsychosis, but it would be of no advantage. We need only notice that on the one hand the adepts of this system have never produced any positive evidence, on the other, that Metempsychosis could never solve the great riddle of Life and Death.

We are told of transformations, of multiplied lives; how could we demonstrate their utility? If I must reach at last a state of perfect happiness, what purpose do these intermediate steps serve? A serious mind cannot waste time on such ramblings.

After all, every theory about the immortality of the soul and its condition in the future life depends on the answer to this question: Why is man on the earth? What is our end, the aim towards which we are tending? Some philosophers tell us that every end that man imagines must be fallacious because "anthropomorphic."

Let us put this hypothesis for a moment; I reply if the end which our reason proposes merits this epithet, it does follow that this end is a mere imagination; but that must be proved.

Every sane, normal person has a reason for his actions. Why, in its last analysis, is the reason always the same? Why, in spite of all the progress and supposed improvements of humankind, do nations as well as individuals still act according to the same principle? Each of us aspires to happiness, to well-being, and it is a commonplace to assert that this happiness is never reached in this life; that every human being must experience trouble and suffering in a greater or less degree.

If the ideal towards which we tend does not exist, the fact that our soul necessarily aspires after it must be explained. Though it is of the psychological order, the fact is one of experience as well; our aim is happiness, we pass our lives in the search for it; it is the motive of all our actions, and we tend towards it as a heavy body tends towards the centre of the earth, as the planet revolves round the sun, as the iron particle flies to the magnet.

You will say: That is a law of nature. But, once more I say, the assertion explains nothing. A law cannot exist without reason, and though a scientist cannot always give the reason, the law necessarily presupposes an author. Let us admit for a moment that God Himself is this author; if that is so, the Law-giver must have proportioned the means to the end; now, between this insatiable thirst for happiness and the means of quenching it, the disproportion is flagrant.

If God exists and possesses all the perfections we ascribe to Him—wisdom, goodness, justice—I can see that true happiness may be reserved for us in another life, and that this life on earth is but a test. If, on the contrary, God does not exist, we explain nothing; neither life, nor suffering, nor merit, nor moral obligation. If it is insisted that we are no more bound to explain these things, than to explain the thunderbolt or aerolite, I answer that a moral problem is one of quite a different kind; its solution must not be delayed; the life of mankind is at stake; society is not possible without *some* morality, and a provisional morality, even if founded on a common agreement, could not create any obligation on the conscience.

All morality, every obligation, every sanction must rest ultimately on the existence of a Personal God, Who has created the world, Who rules it, Who has appointed laws for it, and Who—being the Eternal Wisdom—must have made it for a certain end.

Whether we will or no, the ultimate question, put in baldest words, by no possibility can be anything but this: Does God exist?

Beyond doubt, the sight of the heavens, the wonders of the Universe, the order and harmony in the world, proclaim sufficiently the existence of an intelligent Cause, distinct from the world and from Matter itself, for the average man to have no doubt that God exists; but the philosopher's duty is to dig deep into the problem, to examine it under all its aspects and thus to bring to light His attributes.

Everything in Nature resolves itself into a concatenation of cause and effect; future phenomena—material ones, that is—depend upon present happenings, just as these arise mechanically from past conditions.

You may say this is merely modification of substances. I grant that; but so far as they are phenomena, these modifications are nevertheless realities caused by something; my consciousness gives me me many examples and it is in this consciousness that I grasp the true notion of causality—a notion simple enough in itself, though giving rise to more than one problem of a transcendental kind.

Imagine two phenomena: if in order that the second may appear the existence of the first is necessary and sufficient, I shall be entitled to say that the first is the cause of the second. When the second passes from non-existence to existence, I have the idea of a newly produced phenomenon which was not there a moment ago; the existence of the first has been its necessary condition.

Moreover my intelligence, by realising the two phenomena, shows me that the existence of the one implies that of the other, in other words that the two cannot come into being together; hence a new idea, that of succession, or Time.*

Scientific men are so convinced of the concatenation of causes, that at every stage of the history of Science the human mind has tried to reascend the ages and discover what has been before our time.

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* I do not pretend to give here a complete theory of Time, which would be outside the scope of this volume. It is enough for the reader to know that our notion of Time must be founded on the relation of causality. Here I do not use the word *together* (ensemble) in the sense of *simultaneous*, since that would be to presuppose the idea of Time; but in the sense that non-existence excludes existence, when both are affirmed without restriction of the same object. But if existence and non-existence are not mutually exclusive, and if they are connected by the relation of causality, we necessarily assert their existence in time.

These attempts have been more or less happy, I grant; they attest the metaphysical and scientific possibility of determining the former conditions of the world. If Science proceeds to mere probabilities or chimerial hypotheses, that is its look-out; what we can be certain of is that if we knew more perfectly the causes acting in the Universe, we should be able to trace accurately the phases of its evolution.

Where should we stop? At its origin, some say. If it *has* any beginning, reply their opponents. And if the Universe is eternal, what meaning is there in any question as to its origin?

In the volumes entitled "D'où venons-nous?" and "Où sommes-nous?"* I have examined the scientific arguments which entitle us to assign a beginning to the world, and I will only refer my reader to them; but our Science changes, our purely scientific theories might have no value to-morrow; it is a hundred times better for us to rely on immutable principles which remain true for all time.

Yes, the world has had a beginning, and I find the best proof of that in its changing conditions. These changes are successive, and themselves constitute Time; for just as Space is nothing *in itself* apart from the relations between the material elements which form the objective Extent, so Time is nothing *in itself*: duration has no existence apart from that which endures and changes.

If a being were immutable it would not exist in Time, since there would be no succession about it; while, where there is succession, there is also change.

Now if the world had no beginning, it has endured since an infinity of Time: in other words, however we reckon units of time or succession, we implicitly assert that the number of those units is infinite at the present hour. And at this point contradictions begin. If the number of time-units is really infinite, the world must cease to exist; for we can *add* nothing to an infinite number of seconds. And yet the Universe continues on its course; it has not yet reached the duration which was supposed to be infinite; therefore such duration never existed.

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* Works by the author, published by the "Editions Scientifica," 87 Boulevard Saint Germain, Paris.

Another consequence; if you hold that the world's past was infinite you must admit that up to the present time it has undergone an infinite number of changes, each of which has had in its turn a realized existence; now, as we have seen, an infinite number realized, made concrete, is an idea repugnant to reason, an absurd, meaningless notion; infinity is essentially indeterminate.

We arrive at the same conclusions with regard to both Time and Space. To maintain that the Universe is composed of an infinite number of atoms, or that beyond the stars which our telescopes can distinguish, there exist others, up to infinity, is to state a proposition utterly devoid of meaning; such verbiage we must leave to the romance writers of Science.

In the same way, we cannot speak of an infinite chain of causes in the past; the present causes have been preceded by others, those by yet others, and so on until we reach a series beyond which we cannot ascend.

There has then been a *first change*, or *first* simultaneous *changes* if you prefer, which have marked the origin of Time. That is to say, a being which *was not* begun to exist; *nothing* preceded *being*, if we may so put it.

If we are asked whether we refer to a substance or a phenomenon, the inquiry is of no importance whatever. If, as all evidence authorizes us to believe, the material element bears its activity within itself, it is impossible to conceive of inert matter, without motion and therefore immutable; and the question as to the First Cause becomes more urgent than ever.

If, as philosophers tell us, I can only by a mental abstraction separate Matter from its activity, its force or *form*, I must resolve this fresh enigma: What has been the cause of this active Matter? And the data of the problem are precise.

Substance has passed from nothing into existence. But it must be admitted that an absolute nothing could not be a cause, otherwise we could conceive a cause which has no existence. Whence it follows logically that for a being to pass from non-existence to existence, there must be a cause distinct from itself.

A cause, obviously; and a cause distinct from itself, for otherwise it would become its own cause, which contradicts our hypothesis, since we began by postulating its non-existence.

We are thus inevitably led to the idea of creation, and of a Being distinct from Matter, who has brought Matter into existence from nothing. The same reasoning holds good for a spiritual Substance, such as our soul, since by its successive operations it is subject to change. It cannot therefore have existed from all eternity, and required a cause to bring it into existence.

Let us not stop half-way, but continue our deductions. When I consider all the changes which have taken place in the Universe, all the beings which compose it, all created substances, material or spiritual, I see quite clearly that not one of them is necessary; we can imagine parts of the Universe non-existent, all are contingent, but since they exist and a Being has created them, this Being Himself is necessary, and we call Him God.

On the other hand, the necessary Being is perforce immutable; there is no succession in Him, therefore no changes; for if He were susceptible of change we could apply to Him the reasoning we have applied to Matter. If there were succession in God, there would also be duration; He would have had a beginning, and this would imply a being anterior to Himself. He is therefore outside of Time; because He is immutable, He is eternal; He is an essential Being, Who can alone give being to His creatures, Who can Himself receive nothing; for if He could, He would increase His perfection by what He received, and therefore would not be immutable.

No limit then can be ascribed to Him; and that is to affirm that He is infinite. Nothing in Him can *become*; He is pure Act, and consequently possesses all perfections. In Him, we repeat, nothing is relative, all is absolute; He Himself is the true Absolute; Absolute Truth, Beauty, and Goodness.

In the order of thought, a thing is only true when it corresponds to its representation in the Divine Intelligence; only beautiful when it realizes the adaptation of means to the end willed by God—and this is true also in the domain of Matter. So too, morality comes from Him, because He is the infinitely Perfect.

If indeed God possesses all perfections, He must love Himself with an infinite love—"*must*," not in the sense of *duty*, but *necessity*. God loves Himself irresistibly, necessarily, and that is why His aim in His creation can be but Himself. Without creation He was sufficient to Himself, but since He willed to create, His creation must exist for Himself and His own glory. As He is in the Beginning of all things, so too He is their End.

"The Lord hath made all things for Himself," Holy Scripture tells us*; and again: "I am Alpha and Omega, the First and the Last, the Beginning and the End."*

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* Prov. xvi. 4.

The infinite Love which God bears to His perfections, which we call His infinite Sanctity, is the ultimate foundation and principle of the whole moral law, what we must call infinite morality, that is, moral perfection in an infinite degree.†

Just as logic and truth do not depend upon a created intelligence, so there is an absolute morality which could not be a function of the creature.

To try to found Ethics on any other data is to build on quicksand. The essential moral act in every creature is therefore the love of God; the love of Truth which is God, the love of Good, which He identifies with Himself; the perfecting of our intelligence by entering into the knowledge of Himself, of our will by only willing what He wills.

Once known as the Perfect One and the Absolute God, God cannot but draw our wills to Him. But it is clear that we must attain to that knowledge. Now during this life our soul cannot attain intellectual knowledge intuitively, but only by reasoning upon given data; God is only imperfectly known by the soul; and yet the instinct that draws towards the good is so deeply rooted in him, that if he does not love God he cannot but seek in created things that reflection of the divine perfections which every being bears, and so we often take the shadow for the reality.

Two duties follow from these considerations: our intelligence must use every means to attain the highest knowledge possible of the Supreme Being and of His perfections; our free will must turn to God as its highest Good, the absolute Good, as our last end and our reward.

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* Apoc. xxii. 13.

† There is, besides, the reason which God gives to Moses: "Be ye holy, because I the Lord your God am holy." Levit. xix. 2.

By what means will the soul be united to God in the future life? That is the point we now must elucidate.

With regard to this we must notice that if divine revelation had not come to our aid, no human philosophy could have ventured to cross the mysterious threshold of the Beyond.

When man, only guided by his reason, tries to lift the last veil where the unknown tracts of the future life are hidden, he only ends by guesses in which sentiment, poetry, and feeling above all, hold the chief place.

The seductive chimeras of Metempsychosis are of a class with the Elysian Fields of the ancients, the Mahometan paradise, and so many other pictured heavens, in imagining which thought beggars itself in its first effort.

To describe or even to imagine happiness seems more difficult to the poet than to picture pains and sufferings. Do we not notice the same in the tympani of the arches in our cathedrals, the work of the sculptors of the Middle Ages? The artists of all ages find it easier to represent the horrors of hell than the beatitude of the just in Abraham's bosom. This is evidently the result of the difficulty of the subject; the artist desires to introduce sensible images where they cannot exist.

A soul coming back from Beyond would be powerless to tell its experiences, it could only repeat St. Paul's words to the Corinthians: "I know that this man heard unspeakable words, which it is not given to a man to utter."

Never has a better paraphrase of this passage been given than by the poet L. Mercier, in his *Lazare le ressuscité*. When his sister asks:

> "But afterwards? Beyond this life, beyond
> This world, hast thou discovered nothing, Brother?"

Lazarus replies:

"—I remember not.
Oblivion deeper than Gomorrha's sea
Hides all the secrets that I glimpsed below.
Therefore as one who wakes from sleep at dawn
Feels buried deep within his soul a dream,
So, filled with dread unspeakable, I know
That buried in that vast forgetfulness
Lie memories that far transcend our ken,
I know my eyes have looked, amazed, upon
That to no human eye vouchsafed, my ear
Caught sounds that never fell on human ear.*
Oh that the lost remembrance might awake,
Come back to me the wondrous dream that still,
I know, obscurely lies within my soul;
Then will I speak! In Sion's highest places
Doctors and priests will summon, all who yet
Refuse their Credo to my Lord's appeal,
And, their hard hearts to conquer, I will cry;
Returned from that abode of dread, I know—
I, Lazarus—the secret of the grave,
Revealed alone within that other world;
Now, I declare this Man the Christ, I swear
The Truth eternal issues from His lips.
But I forget!—A seal I cannot break
Is placed upon my lips, my mouth is closed.
As for a treasure in some vault concealed
I search, all gropingly, my memory,
And only grasp a shadow and a void.
Yes, I forget! What shall I tell my brethren,
What answer to the living who would know,
Like you, the secret that I still must hide?
The clue is lost—I cannot recollect!"
And Lazarus kept silence.†

Never during this life will man understand the happiness which God reserves for the soul severed

* A new paraphrase of St. Paul's words which are founded on a passage in Isaias lxiv., 4. These things are, as it is written, says St. Paul, "things which the eye has not seen, nor the ear heard, and which have not entered into the heart of man, things which God has prepared for those that love Him." (1 Cor. ii. 9).

† Louis Mercier; *Lazare le ressuscité*, p. 36 et. seq. (Calman-Levy, Paris).

from the body; revelation, however, notwithstanding its silences and its mysterious utterances on this subject, gives us indications on which we should meditate.

"Dearly beloved," writes St. John the Evangelist, "it hath not yet appeared what we shall be. We know that, when He shall appear, we shall be like to Him (*i.e*, like to God): because we shall see Him as He is.*

Similarly, St. Paul tells us: "We know in part (now) . . . but when that which is perfect is come, that which is in part shall be done away. When I was a child, I spoke as a child, I understood as a child, I thought as a child. But, when I became a man, I put away the things of a child. We see now through a glass in a dark manner; but then (in the life to come) face to face. Now I know in part; but then I shall know even as I am known."†

What is the meaning of the words: We shall see God *face to face?* This surely:

Even in this life we can truly and really know God. It is enough for us, as we have already said, to consider the Universe, its marvels and the laws which rule it, the order which keeps all in harmony. Our senses perceive at once both the whole and the parts, and while the changing picture unrolls itself before our eyes, while we have a sensible intuition of the phenomena, our understanding grasps the glorious plan which Nature presents to us; then, ascending from the complex to the simpler, little by little it comes to conceive the First Cause of all these effects; finally, concentrating in this Cause the ideas of greatness, truth, and omnipotence; it is led logically to the conception of the true God.

In this intellectual conception intuition has no part; we must use a longer, what philosophers term a *discursive*, method. Is not this the only method which the human mind can use in order to arrive at scientific truth? Subordinated as it is to Time, by reason of its union with the body and the relations of its sensibility with Matter, the changes of which imply succession, not only does our understanding need sensible images to increase its acquisitions, but it can only slowly and gradually arrive at the knowledge of all human Science. Follow step by step the intellectual conquests of humanity, and you will see what an amount of labour, of generalisations and hypotheses, has been necessary in order to obtain our present results.

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* 1 St. John. iii. 2.

† 1 Cor. xiii. 9-12.

From experiments renewed a thousand times it has been necessary to infer laws, to eliminate mere accidental phenomena, true microbes which modern Physics can eliminate by a wealth of technical methods; to the results obtained calculation has then to be applied, general facts must be grouped in a convergent harmony, must be reduced, in short, to a unity, a fruitful principle from which flow all the results obtained. From the heights thus reached it is given to human understanding to embrace in one survey, and beneath the same horizon, the most various domains.

Viète ponders the multiple properties of numbers which he teaches us to generalize, and by which he succeeds at the same time in laying the foundations of Algebra; this mighty lever Descartes proceeds to use for the discovery of Analytical Geometry, and in the hands of Leibnitz it gives us the principle of the Differential Calculus.

Keppler, after twenty-six years of labour, succeeds in demonstrating that the planets describe ellipses round the sun, and thus prepares the way for the immortal discoveries of Newton, that famous genius who proved that the worlds pursue their orbits according to mathematical laws.

Is not this reduction to simplicity, to unity, which makes all our sciences so fruitful, a proof that there exists outside of ourselves, beyond our experiments and our *data*, a unique Principle of truth from which proceeds all Science?

A mind great enough to take in at one glance all the facts of the Universe, to conceive all the laws that rule it, and to unite them in a common design, to discover the identity of the beginning, the unity of the end, the simplicity of the means, would possess the transcendental knowledge, the Science from which all other sciences proceed, all knowledge and all truth; in short, it would penetrate the divine Idea which embraces in itself alone the essence of all things, whether realized or simply possible; having thus comprehension of the divine Essence, so far as a finite mind can grasp it, such a mind would have intuition of the Eternal Truth. And if this were so, it is obvious that such a mind would *see God*.

For us, *to see* implies the sensible intuition of an object; the inmost heart of things remains unknown. No doubt, we ascend from the phenomenon to the cause, and we cannot doubt that substances exist, but we shall never know in this life of what their essence consists. Our soul itself is only known to us by its operations, but the essence of the subject, of my *self*, my innermost being, escapes us; therefore there is no pure intellectual intuition here below. Nevertheless our understanding informs us that such intuition is possible; it is indeed the proper object of our intellectual faculties, the object they would perceive immediately if they did not act through the medium of the body; in other words, an intelligence, considered in itself, can see but the very essence of things. Such comprehension is truly the last term of the act of knowing, and this why, borrowing from the sensitive domain a term which expresses most exactly for us the complete manifestation of truth, we apply to intellectual intuition the name of *intuitive vision*.

If, then, we tend towards God as our last end, the supreme intellectual act, that which will secure the complete satisfaction of our understanding, must be able to manifest to us clearly the essence of God Himself. And if we possess this divine essence by our intellect, our will cannot but repose in it by a perfect love. This is what it is to see God, no longer through the perfections He has bestowed upon His creatures, as in a mirror, but face to face, as He is; to see in Him the essence of all beings, which realize in part the divine Idea, to penetrate to the bosom of His divine Intelligence; to adhere to Him by our will which therefore cannot choose but love Him eternally: these are the two ends which in the *Beatific Vision* are united, that Vision which God reserves for the soul which has merited to behold It.

But Revelation goes still further, and teaches us that if we cannot hope to know God wholly, yet our souls by virtue of a supernatural gift will penetrate into His intimate life. Who could dare to claim to understand that life in its divine completeness? "To touch God with the mind," says St. Augustine, "is the sovereign beatitude; to comprehend Him is impossible to man."

No finite being could ever adequately comprehend the Infinite. The Beatific Vision will be proportioned to our previous state of intellectual and moral perfection; and to this Vision, simply by the free gift of God, will be added that of the most august of Mysteries—the Trinity in God.

Such is the teaching of the Catholic Church, grounded on Divine Revelation, to which we must therefore hold fast, not because our reason can comprehend it, but because it comes to us direct from God Himself: "Going therefore, teach ye all nations, baptizing them in the Name of the Father, and of the Son, and of the Holy Ghost," said Christ to His Apostles.*

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*St. Matt. xxviii. 19.

But the same Evangelist has already recorded those other words of our Lord: "All things are delivered to Me by My Father. And no one knoweth the Son, but the Father: neither doth any one know the Father, but the Son, and he to whom it shall please the Son, to reveal Him."* Reason, left to its natural insight, could never rise to the conception of the dogma thus proposed to our faith.

But to speak of a *mystery* is not to speak of a *contradictory proposition*, and without presuming to justify by reasoning the most incomprehensible and at the same time the most august of revealed truths, we may try by analogies to raise a corner of the veil which hides from us the inmost Life of God.

When Moses, in the first chapter of Genesis, gives us in large outline the stages of the world's creation, after indicating the work of the first five days, he leaves God Himself to speak of the creation of man: "And He said: Let Us make man to Our image and likeness"; and in the next verse the writer insists again: "And God created man to His own image: to the image of God He created him,"† a resplendent truth which will enable us to throw some light on the august mystery of the adorable Trinity.

Let us go down to the depths of our understanding and try to analyse what takes place there. How does our soul become cognizant of itself? By the faculty of thought, obviously; and here we encounter a mysterious duality, very real though incomprehensible.

When our intelligence reflects about its own nature, it cannot reach its essence, because in this life it could not possess a true intuition; it knows itself therefore by its acts, and takes these as the objects of its activity. In this case, the object of the intelligence is, then, its own thought, a baffling kind of act, a sort of doubling of which we are conscious and cannot possibly deny.

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*St. Matt. xi. 27.

† Gen. i. 26, 27.

Although *immanent*, i.e. coming back again to the subject, the action displays a real and undeniable duality: on the one hand the cause, which is the intelligence; on the other the effect, distinct from the cause, because it is produced, and can be renewed by, my will; the soul does not indeed double itself, but it has the power of perceiving the modification which it effects.

Are we permitted to develop this reasoning, to generalize it, and apply it to God? Yes, in a certain way, provided, that is, that we never forget that in Him everything is infinite and perfect.

I grant that this is a dangerous philosophical exercise, and we are happy indeed in having the Faith for our guide. The proof of the danger lies in the numerous heresies, especially in the first ages of the Church, which arose from rash speculation in this field of thought.

However that may be, the following line of reasoning may permit us to see in God a glimpse of the necessity of the Trinity.

When God, the infinite Intelligence, thinks His own thought, this cannot he a modification of His substance, since in Him nothing can *become;* He is simple, unchangeable Being. He could not have begun to think, since He is outside of Time; God thinks then His own thought from all eternity, and since this thought is necessary, perfect, infinite even as Himself Who from all eternity begets it, this thought can be nothing but God Himself.

This infinite thought of God is His Word, "the image of God,"* the substantial, complete, and perfect reproduction of Himself, having full and perfect consciousness of His own existence, therefore possessing true Personality, not distinct therefore in substance from Him Who begets, but distinct in Person; *non creatus, sed genitus* our Creeds declare; and the Word of God, Who is none other but Christ, calls Himself the Son of God.

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* Col. i, 15.

We apprehend then why this Word, the Image of the Father, "the Brightness of His glory, and the Figure of His Substance," * Who contains in Himself the essence of all things, both realized and possible, must be He "by Whom God made the world," † as St. Paul tells in various passages of his Epistles: "For in Him were all things created in heaven and on earth, visible and invisible . . . all things were created by Him and in Him," ‡ a sublime truth which no human mind could discover, and which justifies at once the mystery of our glorious destiny and of our origin.

So, in the prologue, overflowing with lyric eloquence, with which St. John, the Apostle of Charity, opens his Gospel, we are told:

"In the beginning was the Word, and the Word was with God, and the Word was God. The same was in the beginning with God. All things were made by Him: and without Him was nothing made that was made. In Him was life, and the life was the light of men . . . And the Word was made flesh, and dwelt among us.§

Yet the Divine relations, the essential life of God, do not cease even at this point.

As we love our own thought, God loves His. How could it be otherwise, since His Word, His Image, possesses all His perfections? The mutual love of the Father and of the Son is as necessary as it is infinite, and, as Lacordaire beautifully expresses it:

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* Heb. i. 3.

† Ibid. i. 2.

§ Col. i. 16.

§ St. John, i. 1-4, 14.

" From the result of His thought and His mind, from the Paternity and the Sonship, arises by a single movement Him Whom we call the Holy Spirit, that is, the Breath of Love, which passes from Father to Son and from Son to Father, and which makes of their triple Personality one sole and indentical Love. '*

One of these Three Divine Persons, the Holy Spirit, is not, then, begotten by the Father or the Son, but proceeds from Both, as we read, again in St. John's Gospel: " When the Paraclete cometh, Whom I will send you from the Father, the Spirit of truth, Who proceedeth from the Father, He shall give testimony of Me."†

This is the mystery of the Trinity, appalling in its depths, yet luminous, although " covered by a veil before which our reason bows down; yet the rays which escape to our sight throw a light full of wonders; if the mystery cannot be explained, it is itself a sublime explanation."§ So Balmès writes, alluding to the lights which the mystery of God's essential life, known through the Faith, casts on the mechanism of our intellectual knowledge.

This dogma, on which depends the whole economy of the Religion brought into the world by Christ, the Son of the living God, we can, it is clear, never comprehend here below, but in the other life, in the light of the infinite Intelligence, our soul, united to God, will perceive better the various aspects of the tremendous truth; it will likewise comprehend, so far as a finite spirit can grasp a portion of the infinite Truth, the marvels of love which God has brought into being for our sakes, marvels of the invisible and supernatural world, infinitely more magnificent than those of the material world, which are nevertheless enough to transport us with wonder.*

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* Lacordaire, Conferences de 1848.

† St. John xv. 26.

§ Balmès, Op. cit. Book I, Ch. viii.

Thus when, in that other life, we shall have reached the end which God has reserved for us, that is to say, Himself, our beatitude will be complete, we shall possess the Sovereign Good; our understanding having, like our will, attained the term of its perfection in beholding God, will see in Him and through Him all creatures, not exactly in the way we see them now, but in more perfect fashion—as they are, that is, in themselves.

But here arises a question that may well be asked with anxiety. Can we conceive perfect happiness if our dearest and holiest affections, begun on earth, must end with our present life?

The answer admits of no doubt. The perfection of the soul required by God involves not only the love of Him, the Supreme, but also that of our fellow-beings: "Thou shalt love the Lord thy God with thy whole heart, and with thy whole soul, and with thy whole mind. This is the greatest and the first commandment . . . Thou shalt love thy neighbour as thyself. On these two commandments dependeth the whole law and the prophets."†

This is perfect charity: it includes at once the love of God and of our fellow-travellers who share our joys, our sorrows, our sufferings.

If, then, in the future life we are to be deprived of our dearest affections, the second commandment laid down by our Lord would have no *raison d'etre;* the supernatural and glorious state, like the state of grace, so far from destroying nature, makes it perfect.

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* I would refer the reader who desires to study the doctrine of the Holy Trinity to the *Elévations de Bossuet sur les Mystères;* and to Lacordaire's splendid Conference on *La Vie intime de Dieu;* also to a small volume recently published by Lethielleux, Paris, from the learned pen of Mgr. Landrieux: *De la Trinité à l' Eucharistie.*

† St. Matth. xxii. 37-40.

What an increase of happiness should we not hope for in the other life, from the very fact that we shall be re-united, without possibility of separation, to those whom we have left in this world of exile, and who will have rejoined us, and to those who have gone before us to the Beyond, and who will partake, in God and with ourselves, the supreme beatitude.

Let us not therefore doubt that our souls will find each other in the bosom of God. But the Author of our Redemption has willed more than this, He has reserved for us a still more complete happiness ; this body, now united with our soul, will only be temporarily separated by death. Christ Himself, Who is risen from the dead is our guarantee for this : "If there be no resurrection of the dead, then Christ is not risen again. And if Christ be not risen again, then is our preaching vain, and your faith is also vain."*

But already Christ has gone before us, in His glorified body, to the place which He reserves for us : *Non est hic, surrexit enim, sicut dixit.*†

"He is not here, for He is risen, as He said."

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* 1 Cor. xv. 13, 14.

† S. Matt. xxviii, 6.

CHAPTER XIV

CREDO RESURRECTIONEM

"I BELIEVE in the resurrection of the flesh:" Such is the dogma taught us by the Church concerning one of the most important questions as to the future life.*

Let us notice that our present enquiry has nothing to do with the immortality of the soul. At the last day we shall rise again, that is, our soul at that moment will take again the body which it left on earth when separated from it. †

This belief in the resurrection has not been evolved, as is sometimes asserted, since the ancient Mosaic Law. To tell us of it the Bible employs neither periphrase nor metaphorical expressions.

In the history of the martyrdom of the Seven Brethren, recorded in the second Book of the Maccabees, the second of the brothers, before he dies, thus addresses king Antiochus: "Thou indeed, O most wicked man, destroyest us out of this present life: but the King of the world will raise us up, who die for His laws, in the resurrection of eternal life." *

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* *Credo. . . Carnis Resurrectionem* (Apostles' Creed) *Credimus. . . in resurrectionem mortuorum* (Creed of St. Epiphanius). *Et expecto resurrectionem mortuorum* (Nicene-Constantinopolitan Creed).

† Credo etiam veram resurrectionem ejusdem carnis quam nunc gesto, et vitam æternam (Creed of St. Leo IX).

The third speaks in the same sense: "These [members cut off in his martyrdom] I have from heaven, but for the laws of God I now despise them: because I hope to receive them again from Him." †

And the fourth: "It is better, being put to death by men, to look for hope from God, to be raised up again by Him: for as to thee, thou shalt have no resurrection unto life." §

The following passage from Daniel will explain the last quotation, telling us that even the sinners will rise to a judgment of condemnation: "And many of those that sleep in the dust of the earth, shall awake: some unto life everlasting, and others unto reproach, to see it always." ‖

But we scarcely need these testimonies, since we have the witness of Christ Himself. He thus speaks in one of His discourses: "Amen, amen, I say unto you, that the hour cometh, and now is, when the dead shall hear the voice of the Son of God, and they that hear shall live . . . Wonder not at this; for the hour cometh, wherein all that are in the graves shall hear the voice of the Son of God. And they that have done good things shall come forth unto the resurrection of life; but they that have done evil unto the resurrection of judgment." **

He is not less explicit in the synagogue at Capharnaum: "He that eateth My flesh, and drinketh My blood, hath everlasting life: and I will raise him up in the last day. For My flesh is meat indeed: and My blood is drink indeed."* Thus He gives, at the same time that He affirms the resurrection of the body, the most beautiful of supernatural reasons for it that we could conceive.

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* 2 *Macc.* vii. 9.

† *Ibid* v, 11.

§ *Ibid* v. 14.

‖ Daniel xii. 2. The French translation has: "*Pour une infamie éternelle.*"

** St. John v, 25, 28, 29. [At Jerusalem, after the miracle at the Probatic Pond].

Can we wonder now that St. Paul devotes a whole chapter of an epistle to the resurrection of the dead? Nothing is left obscure, and the Apostle's words will serve the theologians of all time.

Therefore the Church has always risen in her might against the heresies that affect the doctrine of the resurrection, and that at all times of her history.

She tells us by the voice of her creeds and her councils that each one of us will rise again *with his own body*, that is to say, with the body which serves us in this present life, and with no other." †

That the resurrection is a dogma of the faith taught by the Church no one can deny; so some scientists who profess belief in a personal God will confess that for the Creator to vouchsafe, at the end of the ages, to give a new body to the soul, does not overpass the bounds of His omnipotence; what He has done once He can do again; yet the identity of the body, as taught by the Catholic doctrine seems not only a mystery to them, but something self-contradictory and therefore impossible to realize in fact. These are their reasons:

As soon as the soul is separated from the body, the latter re-enters the great whirlwind of Matter.

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* St. John vi, 55, 56.

† Cf. *supra*, Creed of St. Leo IX. Also the *Quicumque* or Creed of St. Athanasius: "Omnes homines resurgere habent cum corporibus suis." Conc. Tolet. ". . . nec in aëria, vel qualibet in alia carne . . . sed in ista, qua vivimus, consistimus et movemur." *Prof. Fid. Waldensibus proescripta*: ". . . Hujus carnis quam gestamus et non alterius." Fourth Lateran Council: "Omnes cum suis propriis resurgent corporibus quae nunc gestant." Second Council of Lyons; "Credimus. . . resurrectionem hujus carnis quam nunc gestamus."

From an organized state it quickly passes to that of disorganization ; azote, hydrogen, carbon, which make up the cell, only to mention the principal elements, return to the earth and mingle with the moisture that covers it. Since Adam's time, we may say without metaphor, humanity treads underfoot the bones and flesh of its ancestors ; we live continually in a world of death, a vast cemetery which man could not respect without dying of starvation, a universal ossuary, where—dismal statement !—the organized being that desires to realize its end in the creation, must seek the elements of its life.

Where human flesh is decomposed, the plant will certainly draw its nutrition ; a beast may eat the plant, and then man will probably assimilate both as his food. Thus by a perfectly natural series of operations the former elements will live in new bodies ; the vital whirlpool is a closed circle, in which every substance comes in its turn to nourish different owners. And there are even people who do not wait for this lengthy process of transformation. A missionary told me lately how hard he had found it to hinder his flock from eating the flesh of their relations. As soon as death is assured the whole family gather round the paternal remains, and everyone thinks it his duty to devour a part of the defunct. Here is human flesh which beyond all controversy will belong to several individuals. What will happen at the resurrection, and how will Divine power effect the division of it?

Our body, some theologians have answered, is renewed several times in the course of our existence ; it is enough if the risen body contains any one of the material particles it possessed during life, for its identity to be preserved.

That will not hold water, it is replied ; in any case it appears quite proved that the earth does not contain enough disposable material to nourish the organic world, and human bodies in particular, indefinitely.

This objection which was put to me by a man of science—although futile for the present argument, as we shall soon see—seemed sufficiently specious, and typical enough to justify my idea of submitting it to calculation.

The average human life is 33 years, and one will scarcely go wrong in reckoning three generations to a century. Let us limit our operations at first, for the sake of simplicity, to the last 4,000 years. We may reasonably presume that during this time 120,000 millions have inhabited the earth (say 1,000 millions at a time). If we allow 50 kilogrammes for the average weight, we only obtain six billions of kilo. for a period of 4,000 years; and since the earth weighs six sextillions of kilo., one sees that even admitting an antiquity of 20,000 years for the human race, the whole of mankind would still weigh 200 million times less than the globe which supports it. Terrestrial materials are therefore far from being exhausted.

But if we wish to take into account only the disposable organic matter, it is obvious that this is very much more restricted. We will try to determine the weight of it. We can assume a minimum, the most unfavourable position for our argument. Supposing a layer of *humus* one mètre in thickness spread over the surface of the continents, we arrive at a volume of 145 billions of cubic mètres, consequently—the density being about 25—at a weight of 3,625 billions of kilogrammes.

But even if the layer were of too slight a depth to nourish the existing organisms, this is not the case when we include the atmospheric humidity. Thanks to evaporation, to marine and aerial currents, the aerial and aqueous molecules are constantly at the disposal of the plants, animals, and the human race. We must then add their known weight to what we have already reckoned, and the final sum is as follows:

Humus	3,625	billions of kilo.
Water	1,500,000	„ „ „
Atmosphere	5,000,000	„ „ „
Total	6,503,625	„ „ „

That is, six quintillions and a half of kilo. or 65 followed by 17 noughts.

If we compare these figures with those which give us the weight of one generation of men, we see that the human race could live 4,000 millions of years before having used up all the available organic matter. By another calculation one could show that this would serve to nourish for 400 millions of years all the animal life of the globe. These are the *minimum* figures which suffice to dispose of the objection offered by the *savant*.

But to my mind all such discussions are mere childishness. The real point of the problem is easy to find: the question, *au fond*, resolves itself into what we mean by a single word: by the *identity* of our body.

"The risen body," says Mgr. Freppel, "will be identical with the mortal body. But in what does this identity exactly consist? Will it be destroyed unless the body of each person regains at the resurrection the same molecules of which it was composed during this present life?

"Here we quit the domain of dogma to enter that of free opinion. The Church has indeed defined that men will rise *with their own bodies*, *those which they now bear*, as the Fathers of the Fourth Lateran Council express it—cum suis propriis corporibus quae nunc gestant; but the Church has not determined what constitutes the specific and individual identity of our bodies. . . . It would, also, be true to say that we shall rise with our own bodies, even if we did not recover one of the molecules which made a part of it before death, provided that the risen body reproduced the specific characteristics which previously distinguished it. But we do not see why it should be more difficult for Divine Power to restore to each body its own elements than to recompose it of strange ones."

We have thus clear notice that we must face the serious question of Identity. Can Science give us any help ? That is what we are about to see.

First of all, we must distinguish between psychic and physical identity.

"Yesterday I did such and such a thing; I took a walk in the country, I occupied myself in drawing; to-day I went to the town. I visited such and such a monument; to-morrow I shall rest, I shall read this or that book."

I state all these facts, not merely as a list of successive events, but as a connected series, in which I perceive relations of cause and effect.

Again: these facts appear to me as successive, because they are linked together, and since that is so, there must be an Ego that links them, in other words an entity which joins together things that are separate. My consciousness is, then, the single receptacle in which they all meet. If I do not admit this, I can explain nothing; but if it is through the unity of *Myself* that I group this series of events, I conceive that those of them which do not yet exist, and will exist to-morrow, belong to me as much as those of yesterday.

If Taine had seriously reflected on this fact, perhaps he would have seen more clearly that after all psychic identity is the only identity we can perceive without effort, because it is the only evident one; it forms part of certitude. And if some philosophers have attempted to prove the identity of the thinking Ego with mere succession—*i.e.* perpetual change—I say unhesitatingly that they have let go the substance for the shadow.

This notion of identity, which is so absolutely clear when applied to the conscious force within us, is certainly obscured when we apply it to Matter and material agglomerations.

You own a house, and for some reason you remove it to another place. Is it the same house? Yes, of course. And if you transfer the materials one by one and rebuild them as they were before, will it still be the same house? You will again say yes, without hesitation.

Now, supposing that the stones are all the same, but joined together by different mortar; does your house remain the same? Or, still better, suppose a clever chemist has been able to substitute for the molecules composing your house, other molecules of the same kind, are the two dwellings, the new and the old, identical?

You will not hesitate to declare that you know nothing of any substitution, because nothing will be changed in the completed building. Here is a factitious, which you will not distinguish from a real, identity. For if you persist in saying they are actually the same, your chemist, to puzzle you hopelessly, has only to take you to the old building, which he has kept, to rack your brain.

Who is right? One atom is not another. Quite so, but what is the difference? If there were any, the chemist could not foresee a reaction; but we know that it is absolutely the same to him whether he makes use of one atom of hydrogen or another.

And yet we feel that after all every atom has its individuality, otherwise we should arrive at the problem of the *indiscernibles*, as Leibnitz expressed it. From the mere fact of their position in Space, that is, by their past and present inter-relations, atoms have certainly something in themselves which keeps them from being "indiscernibles." Nevertheless, the relations of Space required for physical identity appear very tenuous in the two following instances:

Here is a small piece of wax; if we heat it, we can press it into all manner of shapes, but whether the shape is a cube, a pyramid, or a sphere, we call the piece identical, because the condition of the wax is the same. Now if we burn it, all its constituent parts become gaseous; does the original identity still persist? The atoms have not changed, because they are indestructible, yet it is impossible to say that the whole is identical. Yet we should almost attribute physical identity to a quantity of water in a closed vessel like Papin's receptacle [marmite], which was continually passing through three stages: solid, liquid, and gaseous.

Now if we apply these contradictory results to our body, how could we prove its identity, on the supposition that during life the molecules are being continually replaced by new arrivals?

If we admit this kind of identity, in spite of all changes, how can we deny identity to the house, the piece of wax, the quantity of water, of which we have been speaking? One might as well admit the identity of Jeannot's knife, of which the blade and handle had been successively renewed.

But all these difficulties tend to disappear as soon as we speak of identity as applied to a being having a psychic existence; in this case, physical identity becomes almost a mere accessory; there is a substantial tie to unite the Matter, though it seems to us difficult to admit that the whole bodily substance can be changed and at the same time the identity preserved. It is no solution to talk of a slow and successive change of atoms. This is simply to divide the total difficulty into a crowd of little difficulties. What we have to do is to resolve the following problem:

During a man's life the molecules that compose his body are removed one by one, and all the time are being replaced by other similar molecules, in order that he may continue to live.

Suppose an almighty Being to gather together the molecules which have escaped from the first body in order to build up a second, the exact reproduction of the first. If the identity consists only in the accidental shape, in the spatial relations involved, how can we distinguish the two bodies, of which the one is the replica of the other? The soul of the second will not be that of the first, I grant; yet you have not solved the question of corporeal identity.

Where can we find a common ground?

Thus stated, the problem does not exactly admit of solution, if we lay down as a principle that the reciprocal positions of the atoms in Space suffice to secure identity. We have seen that we cannot *imagine* any inorganic body within our Space, and our efforts would fail still more evidently if we tried in the same way to construct a living cell. But in spite of this fact, which has been demonstrated over and over again, we go on trying to imagine sensible representations, we are unceasingly bound to quantity and accidental form—the spatial form of three dimensions—and we pass over *quality*. The qualities then entirely escape us, and we cannot say exactly in what they consist.

And yet when we deal with the living being we catch a glimpse of part of the enigma, we lift a corner of the veil. That we shall proceed to show in the next chapter.

CHAPTER XV

IS OUR BODY RENEWED?

A LIVING being has often been compared to a river which always runs in the same bed, washes the same banks, irrigates the same countries. If the comparison is just, our organism is essentially in a state of flux. New nourishment repairs the loss; one particle replaces another until of all the materials at present existing not one will be left, since every one will in turn make room for a new particle.

But when one speaks of a river, no one misunderstands. The Seine is really a fictitious entity, the creation of pure reason; the water that flows under bridges of Paris at this moment is not that which flowed there a year ago, there is no physical identity in this case; and if my body in the same way preserves only an accidental form, which is simply a question of Space, I do not see why we should persist in trying to discover any physical identity for it either.

Yet, in spite of everything, the analogy does not seem perfect; I have the interior conviction that there are in me things that remain. I do not speak here of my soul, whose persistence is beyond doubt as we have proved, but of that material organism which is united to my soul by such intimate bonds that the two together form the human being which is Myself and no other.

Is not this *something*—this *je ne sais quoi*—the very principle of physical identity? "Mere illusion," reply some physiologists; "in our body all passes away, nothing remains; in a few years the entire body is renewed, and your body of to-day is not that of twenty years ago."

That I have changed much in the last twenty years appears to me the most obvious thing in the world, and I do not need men of science to tell me so; but on what facts do they rely in order to assert an absolute mutation of my body? We must examine this very closely, although the assertion is made clearly enough by some scientists, and is to be found on almost every page of some treatises on Physiology.

Besides, to test Science is not to doubt it; it is at most to verifiy the data, and to enquire if the conclusions deduced from them are legitimate.

And indeed we have good reason to do this. First because usually Science does not speak; it is the scientists who create a language for her. In the second place, because Science has always lived on hypothesis: one makes way for another, and after a certain time has elapsed it is not usual for the former one to reappear.

For instance, what can Science tell us about our origin? Absolutely nothing, it can only stammer contradictory theories. For creation it has tried to substitute evolution, without being able to produce any precise formula. After Darwin it extolled Lamarck, then Hugo de Vries, to-morrow it will be a fourth scientific teacher; even if the question of evolution were settled in one way or another, we should be no further advanced. How and why did Life appear on the earth?

Mechanical atomism was to explain everything, forty years ago; you know what has become of that theory, and of many others.

Now the cream of all this lies in the fact that all our theories—almost with our scientific expressions—are to be found in authors who lived many centuries ago. Read again the famous poem of Lucretius,* and you will see how, according to him, Nature has arrived at perfection.

She hesitated for long, endeavouring to bring to light most various forms of life, but, adds the poet, many of these were unable to survive because, lacking mouth or eyes or mobile members, they could not seek their nourishment nor escape danger. She had to make many attempts in order to produce animals capable of sustaining the struggle for existence. Natural selection, survival of the strongest, struggle for life—all this, one sees, is not Darwin's invention. And, what is still more remarkable, Lucretius is only repeating Democritus and Epicurus.

And do our modern philosophers teach, *au fond*, differently from Lucretius, when they make the origin of the Universe a play of atoms, where intelligence has no place, and from which intelligence emerges one fine day by mere chance?

Let us distrust theories until they can be proved; let us make them pass through the sieve of an impartial and conscientious examination.

The doctrine of the renewal of the body, which has been for some time admitted as a demonstrated thesis, rests in great measure on the experiments of M. Flourens; the reader will be glad to have the very words of the celebrated physiologist produced, the better to appreciate their import.

"I put a platinum wire round the bone of a young pigeon. Little by little the wire was covered with successively-formed layers of bone; soon it was not outside but in the middle of the bone; finally in the medullary canal itself. How did that happen? How is it that the wire which surrounded the bone is now covered by it, that the ring which at the beginning of the experiment was *outside* the bone is now *inside* it?

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*De Natura Rerum, lib. V. ver. 834 sqq. Lucretius lived in the 1st cent. B.C.

"The explanation is that while on one, the external, side, the bone acquired new layers which covered the wire, it lost on the other, interior, side the old layers, which were shed. In a word, the whole bone that the ring surrounded had been shed, and the present bone that now surrounds it had been formed since; the whole material of the bone has therefore changed in the course of my experiment."

Flourens also gives another result of the same kind:

"I placed a small plate of platinum under the periosteum of a long bone. Little by little the plate was covered with osseous layers, as the ring had been. It was at first outside the bone, then inside, then finally in the medullary canal; renewing the wonder of the ring that was first outside and then inside. The bone, at first *under*, is now *upon* the plate; or, more clearly and exactly, all the old bone has disappeared, a wholly new bone has been formed. The bone which exists to-day is not that which existed when I applied the plate, but formed since; and the former bone is no more, having been completely shed.

"The whole bone—all its matter—therefore changes while it grows; there is in every such bone two inverse and opposite phenomena—a converse and an inverse, if I may so put it; a converse by which it is constantly acquiring fresh molecules, and an inverse by which it is constantly losing the old ones, or rather, to speak more strictly, a developing bone is not a single bone, it is a series of bones which replace and succeed each other." And from this Flourens concludes:

"All matter, every material organ, all being appears and disappers, is made and unmade, and one thing alone remains—that which makes and unmakes, which produces and destroys, that is, the Force which dwells in and rules all Matter."*

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*Flourens: *De la Vie et de l'Intelligence*, pp. 16-21.

From all this one writer infers, somewhat precipitately it seems to me:

"An animal, a man, is a reality, a form across which a current of Matter is incessantly flowing. It receives what is necessary and rejects what is superfluous. In this it resembles a river, a cataract, a stream. The particles which composed it a moment since are already dispersed, it can only continue to exist by receiving new ones."* Another writes: "This exchange of materials which is the mystery of animal life, takes place with extraordinary rapidity . . . The agreement of the results obtained by various experiments is a positive proof of the hypothesis according to which *thirty days* are required to give a whole body a new set of particles. The seven years which popular belief assigns as necessary are therefore a colossal exaggeration."†

These *thirty days* are really marvellous! On what possible ground can such conclusions be founded? Most frequently, from the more or less rapid elimination of certain substances introduced into the organism. Dogs, for instance, have been fed with nourishment impregnated with linseed oil, and linseed oil has been found in all their tissues; when this special feeding was stopped the oil was found to disappear rapidly.

"There is no fear that I shall question these results," says Delbœuf humourously, "and I grant readily that if it were possible to make a dog swallow petrol, one would probably find petrol in all its organs, perhaps even in its hair and claws."

"But what does that prove? Only that the tissues are either porous or susceptible of impregnation by certain liquids. Even if the tissues retained such liquids, nothing whatever would be

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*Draper: *Les Conflits de la Science et de la Religion*, p. 91.

†J. Moleschott: *La Circulation de la Vie*, Vol. I. p. 150. (Germer et Baillière, Paris.)

proved. Paper is stained by oil and alcohol ; the first remains, the second evaporates ; neither one nor the other ever becomes part of the substance of the paper." *

But the difficulty raised by Flourens' experiments is not solved. As a matter of fact, the growth of the bone from the outside to the inside was suspected long before the famous physiologist's time. His experiments date from 1840 ; just a century before, in 1740, Duhamel had observed that a pig fed with madder-root showed, under the casing called the periosteum, a distinctly red zone ; a diet of alternate madder-root and ordinary food produced interior zones alternately white and red.

Modern Physiology has also demonstrated that the bone certainly shares in the life of the organism. It is provided with numerous ramifications, intersected by canals connected with the circulatory system, and the periosteum *makes* bone just as the liver makes sugar. This function makes most wonderful surgical operations possible.

In certain diseases of the bone, the bone can be scooped out, so to speak, if the periosteum is healthy ; it undertakes the restoration of what has been removed. If the periosteum itself is partly destroyed, it can be repaired with a piece from elsewhere, which speedily becomes one with the casing. †

In this connection our surgeons show incredible boldness ; but if you question them as to results, they will tell you that the osseous functions diminish with age. Let us enter into some detail : the bone follows a marked evolution during its existence ; simply mucous in the embryo, it becomes

[illegible]

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* Delbœuf : *La Matiére brute et la Matière vivante*, p. 110 (F. Alcan, Paris).

† Experiments of the celebrated surgeon L. Ollier, 1898.

cartilaginous and gradually ossifies; ossification is usually complete about the age of 20, or 25; from this time the work of the periosteum becomes less necessary, the calcareous substance (chiefly phosphate and carbonate of chalk), which extends between the osseous cells, occupies a more and more preponderating place; the bone being completely formed ceases to grow, and it seems difficult to admit that the interior ossified matter can be the seat of movements which always involve assimilation and de-assimilation. *

lime

Everyone knows, besides, that with old people the fracture of certain parts of the skeleton, such as the neck of the femur for instance, is irremediable; knitting together any fracture becomes difficult; the periosteum tends little by little to become nothing more than a fibrous casing, having lost all cellular activity.

In all these phenomena of renewal which a superficial examination would tend to generalise with regard to the living organism, we must then distinguish between the period of its formation and that when it is definitely constituted.

The teeth push through the gums and grow, but whom could one induce to believe that their substance renews itself? If this were so, we could not understand how a rotten but disinfected tooth could not repair itself.

When the shell-fish and snail have spent vast energy in collecting the chalky salts that are to form their external organism—in a word, in building their house—do you think this can renew itself? In the long run will it not become impaired, like our skeleton? One can certainly by a graft of bone repair the machine, add a plate or a bolt, but it will be another machine that has furnished the materials.

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* Cf. E. Gley: *op. cit.* p. 133, sqq.

And in the vegetable world, does the trunk of a tree, although impregnated with sap and possessing a true circulation, show substantial change? And besides, to what purpose would be this perpetual change? Why should the first materials have lost their original qualities? None of their functions makes such a transformation legitimate.

If a child is deprived of carbonates and chalk Calcu phosphates, the skeleton does not develop, and the infant becomes hopelessly rickety, there is no doubt of that; but would it be the same with an adult? That is what needs to be definitely established.

Modern Physiology has demonstrated beyond doubt that a normal adult loses about 25 grammes of mineral substances per day; these must be replaced if he is to remain alive, but the utilisation of this inorganic matter takes place differently in the fully developed man and in the child.

In the infant the bones grow so rapidly that the skeleton increases by about one kilogramme in weight during the first year; it assimilates 4 or 5 grammes of chalk phosphates per week. With the adult, in whom growth no longer takes place, the mineral substances play a very important part; on the one hand mineral salts fulfil an essentially constructive, *plastic* rôle, on the other they are chiefly *functional*, and it is difficult at present to say to what extent the phosphates of the adult skeleton, for instance, enter into the general circulation.

Another riddle to be resolved is this: If the whole body is renewed, how are we to explain the impossibility of curing gout or rheumatism by medicine, and that these diseases, of which we can only lessen the effects, are nevertheless hereditary?

The quantitative value of the elements and their relations in Space explain nothing at all; once more, we must take the qualitative value into account. In this respect we have much to learn from experiment, and the problem is far from being resolved. And since, on the other hand, experiment will never be able to reach the ultimate material particles, we shall never be compelled to admit the universality of changes which have been partially ascertained.

If the least grain of Matter continues to exist in our bodies, the theory of renewal goes to pieces, *ipso facto.* Now what embryogenist at the present time would take on himself to prove that this grain of Matter does *not* exist in our organism ? As a fact, it does exist, as we shall soon see : it is therefore quite incorrect to talk about the vital whirlwind which sweeps away with itself *all* the matter of the living organism. All that we can say with certainty is that in the human body some substances pass away, while others remain. We see now the weakness of the arguments which some apologists use to prove the existence of the soul, relying on Flourens' experiments.

" Every material organ —the whole being—appears and disappears " said the old Physiology. We now know what such affirmations are worth, going as they do far beyond what the experiments of the past centuries have established.

Surely we must prefer to these arguments, founded upon a science still in its infancy and which could never claim to be an absolute science, the metaphysical proofs supplied by the *philosophia perennis* which will always be secure from the attacks of Positivism.

To sum up : the least defect in the hypothesis of entire renewal of the body during this life was to destroy the conception of physical identity, or at least to relegate it to the domain of negative entities.

From the philosophical standpoint, we may unhesitatingly affirm that this hypothesis was connected with the Cartesian theory, which looks on the soul as a pure spirit linked with Matter ; whereas the *natural* condition of our soul is precisely to be united to a body in order to form a substantial whole, the human compound, that is, Man.

From the medical standpoint, the same hypothesis closed beforehand the door to possible explanations of our bodily predispositions, therefore to the researches of logical and experimental Therapeutics.

From the physiological standpoint, it left in the shade (not without good reason!) many facts, the existence of which it wished to ignore: relations that exist between soul and body, acquired habits and qualities, innate individual tendencies (I mean the inclinations of the body from the hour of birth), which do not concern the soul alone, since most often the soul only submits to them, aud deplores the defects which Nature imposes on it.

Finally, there arises a last question purely theoretical, but which a naturalist should not overlook: if it is of the essence of Life to be continually flowing and to resemble a torrent which wears away its bed and its banks, to replace them by fresh mud—why does Life end in Death?

Let me explain my meaning. If the soul alone remains unmoved in the midst of this unceasing whirlwind of Matter; if it is the soul's power that masses the materials together, why is not Life a continual growth? Man develops from birth to puberty, his body reaches maturity; for a few years he remains in this quasi-stable condition which is itself the forerunner of decay.

When comes this wear and tear, this exhaustion? To reply that it is the doing of the soul does not satisfy our reason; the soul being simple and indivisible cannot be subject to the law of mortality.

It is the "human compound" that grows old, and as the cause of this decrepitude cannot proceed from the soul, it must necessarily depend upon the body, upon Matter; and it is here that we must seek for it.

But here is another difficulty: if our material capital is continually increasing, one does not see why the imported materials should suffer depreciation by being incorporated into the organism. Because they have come later into the bodily mechanism, the molecules of azote, carbon, and hydrogen, are neither better nor worse.

Step by step we come to see that, if we will take all the facts into account, we are inevitably led to seek for a hypothesis entirely opposed to that of integral renewal.

CHAPTER XVI

THE IDENTITY OF THE INDIVIDUAL

If the body does not renew itself, wholly and many times during our life, we must conclude that the living being contains *something which belongs to him*, and to no one else, a corporeal material which is the essential ground of his individuality, something with which he is born, which is his capital and his heritage, and that it is this which acts in dependence on the soul. This, whatever it may be, is the foundation of that mysterious Identity into which we must now enquire ; we are conscious of it in the intimate depths of our being, and we feel that it alone can supply us with the solution of the problem of individual Identity.

But how can we reach it ? Some physiologists never mention it ; most people, even well-educated people, still content themselves with the conclusions—very precarious ones, as we have seen—based on the experiments of Duhamel, Flourens, and others. And yet an analysis of the most surely ascertained facts, as also the general tendency of modern Science devoted to the study of the living creature, is well-fitted to put us on the way to the citadel where this Identity, apparently inaccessible, takes refuge.

Let us begin by studying the development of the living creature, it will not take us long to distinguish clearly between what it is and what it is not. Leaving on one side the embryonic life, we can say that every individual, from the moment of birth, is at once conscious of the necessity of providing for his life. How does he do this ? By *aliment.*

But if this word, in its common acceptation, means a collection of materials of which we have a very clear idea, this is not the case when we try to fix the use and division of these alimentary materials. Here we enter the domain of pure Physiology, and if we take the trouble to collect the various definitions of "aliment," we shall probably be no further on. Some will tell us in what it consists, materially speaking, and the whole chemical nomenclature will be put before us ; others will dwell on the food ration and tell us the diet necessary for our maintenance.

We lose every day, by the waste of our organism, under the form of secretions or unutilized products, materials which must be replaced, we replace them by the absorption of nourishment, solid or liquid. Now, whatever may be the particular kind of aliment, if we wish to maintain the organism in proper condition, we must obtain 2,500 grammes of water, 20 grammes of mineral salts, 400 grammes of carbon hydrates, which are to be found chiefly in vegetables and cereals, and are converted into sugar ; 65 grammes of fatty matter and 107 grammes of albumenoids which we extract from flesh-meats, fish, etc., without reckoning the oxygen that we must absorb by respiration.*

Such is the ration for an adult ; but to what end, in the ultimate analysis, are these substances destined ? That is what we need to know. If the aliment is all that sustains life, why does this expedient fail us at a given moment ? Is there a difference between the utility of the aliment provided for the growing organism, and given to one approaching death ? Most certainly, and a single observation will prove this.

Certain birds swallow stones ; the snail and the oyster, like the infant, require to absorb calcareous salts in abundance. Are these substances aliment? Not for the bird, through whose stomach, in order to aid digestion, they pass just as they are; but certainly for the others, in which they serve to build up a solid osseous system.

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* Armand Gauthier : *L'Alimentation et les Regimes chez l' homme sain et chez les malades*, pp. 98-100 (Paris, 2nd ed).

We must therefore distinguish between the aliment which goes to construct and build up the individual, and that which maintains him.

The whole time between birth and puberty is employed by the individual in forming himself, in realizing the plan of his creation, and since aliment is potential energy, one can say that during this part of his life he establishes this energy according to the conditions of his constitution; he prepares the engine, the wheels, the pulleys, the connections—in a word, the mechanism, (an unstable mechanism, let us never forget, in its very essence) which later on will operate with the maximum of result. Does that mean that during this stage the energy will not be partly used for sustenance? Certainly not, but I have insisted on the point to make it clear that at the beginning this energy serves *chiefly for the construction* of the building and of the mechanism.

Thus then, the adult is formed; the machine works, but already this important part of the organism is distinct from that of his neighbour. Receiving different impressions, it has re-acted differently, reflex actions are created, habits are acquired, such and such organs are more or less developed by exercise. This individual has exercised the muscles of his arm, another has practised singing, a third has learnt to play the violin, a fourth the piano, and so on. Each has therefore stored up energy under this or that form; his machine has become qualified for one kind of work more than another; will you say that there is no difference from the organic point of view? These acquirements, registered and fixed in certain parts of the organism—muscles, brain, nerves, etc., are what will constitute, properly speaking, individualized characteristics which cannot but grow stronger under the combined influence of soul and body.

All this, it will be said, can fit in with the doctrine of the integral renewal of the corporeal material. One by one the molecules pass away and are replaced by others ; the new arrivals, since they fulfil the same office, keep the machine working, just as in a factory an attentive engineer keeps a watchful eye on the apparatus, replaces a missing part, repairs a wheel, or puts a connection in order.

Now, once more, whence comes the wear and tear ? We have already established evident facts which have shown us that certain parts of the organism cease at a definite time to grow and be repaired. A careful study will tend to generalize this fact.

Living matter differs from artificial machines in being able to repair itself ; we have quoted the case of bactricians, and could give others. Speaking generally this capability appears to grow less in proportion as we rise in the animal scale ; in every case it is always limited ; a claw can grow again, a heart, liver, or kidney, never. In the higher animals the loss of a phalange is irreparable, a scar is visible all through life, and so is tattooing, and this latter is incomprehensible if Matter renews itself ; it is not a question of a simple wound or accidental loss of substance, but the introduction of a colouring matter which the vital stream should slowly eliminate. But this does not take place, because from a certain age the skin itself does not change.

This restorative faculty, the power of which varies in inverse ratio to age, we shall see yet better demonstrated in the following example.

Everyone has heard of those cases of hemiphlegia, unhappily too frequent, in which one half of the body becomes paralysed ; they are most frequently due to the rupture of a blood vessel in the brain. If the accident occurs in the left hemisphere it usually produces *aphasia*, that is, loss of articulation. If the patient recovers he is incapable of speech; it is necessary for him to repeat his whole education in this respect, and to learn to use other cerebral centres in order to pronounce syllables and words corresponding to his ideas; the lesion can form a scar, but cannot be repaired. Now Kussmaul mentions similar pathological cases where the subjects have been able to learn to speak again, though a notable part of the left speech-centre and even the mantle of the whole left hemisphere had been destroyed. But these cases were all of children.* While their organism was in process of construction they had reserves of energy at their disposal.

Thus from a given moment, what we call our organic material, the stock we have built up, ceases to be capable of repair. So long as the parts remain in outline or even in process of construction, the energy drawn from the aliment can secure repairs, or supply for deficient organs by certain artifices; the work once achieved, the factory works normally and supplies its own needs.

What marvellous harmony exists in this whole organism, in which the smallest details are foreseen; in which the routine of a workshop echoes through all the centres that compose this industrial town which constitutes our body!

But this wonderful mechanism spends its forces; it needs water and coal to keep the motor going; oil to grease the wheels; every centre has necessities of which its neighbour knows nothing. Continual demands are made on it. And then there is waste, though this is not absolute loss; what is usable in it passes into sub-products, such as bile, which are employed on the spot; others are expelled altogether; new arrangements have to be considered, but all is foreseen, the sewage-expenses are part of the budget; impurities are carried away, the kidneys selecting what must be discarded. Sugar is necessary, the liver creates it; oxygen is needed to maintain combustion, every drop of blood undertakes its transport after its passage through the lungs; the heart secures the circulation of the blood; and the brain, by means of the nerves, acts as regulator. In short, when everything is taken into account, the factory that is our body needs 2,250 calories every twenty-four hours in order to keep alive, and as every calory represents a labour of 425 kilogrammes: you see that by the end of the day the work accomplished reaches a pretty total.*

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* Kussmaul: *Les Troubles de la Parole*, Ch. xxxi. If speech or muscular movements are sometimes restored in the adult, there has not been lesion, or destruction, but simply compression of brain matter by the discharged blood. If this is reabsorbed the compression ceases and the functions are restored.

With a man who works hard the calories can reach the number of 4574. That means that every muscle actively engaged discharges heat. The combustion becomes more intense; a part of the heat is recovered by the body, the rest is transformed into mechanical (motor) work. The muscle may be compared to a slack spring; in order to tighten it again, one must put into it the same amount of force as has escaped; aliment makes this possible. It comes impregnated, so to speak, with force, and every part of it like a tightened spring which will supply some of the movement and contribute to the performance of the work.

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* Of this total, 38 calories are required for the cardiac functions. The whole labour performed by the heart, which never rests, since it pumps the blood into all the organs, amounts every 24 hours to 16,128 kilogrammes. The heart of a man who lives a century has therefore performed a labour of about 600 millions of kilogrammes, equal to 8 millions of horse-power. The numbers given are the result of the recent researches of the American school on this subject. *Cf. Papers of the University of Middletown.* Works of Professors Atwater, Rosa, Benedict, Carpenter, and Bayaut.

The analogy between our bodies and machines is therefore striking; but when we reflect, how immensely superior is the animal organisation! It feeds itself, regulates its outgoings, and chooses its fuel. At first sight one would say that it realised the dream of perpetual motion. What an illusion that would be!

Like machines of wood, iron, or steel, our living "machine" is, alas! subject to wear and tear, and what we have called "our material mechanism" cannot, or can only in the most trifling degree, repair itself after its full growth has been reached.

Through being stretched, slackened, and re-stretched, the best violin strings are broken at last; it is the same with our muscles; if a fibre is torn the extremities can be rejoined, but all physiologists will tell you that it is with conjunctive, not muscular, tissue; if the muscle is not hurt or destroyed, it shows, none the less, symptoms of weariness; little by little it becomes less supple, the joints ossify and ankylose, the pulse beats more slowly, the respiration grows quicker, assimilation takes place less rapidly, the nutrition of the tissues is less perfect; the cerebral substance becomes almost incapable of dealing with new acquisitions and can only carry on its former mechanism; for it is a fact that old people remember long-past things with far greater keenness than recent events.

The mass of cerebral molecules is not then replaceable. As with a well-disciplined and long-trained army, if a soldier falls, a new recruit can be put in his place; but he cannot be of the same use; he has no training and does not yet know his business. This is the explanation of the fact that every living being wears out, grows old, and is fated to die.

Yet the wear and tear does not affect all the organs simultaneously; some, like individuals, grow old more quickly than others. The machine stops because one of the workshops cannot fulfil its task any longer.

But it can be repaired, we shall be told, and if the theory is true, the life of the individual can be thus preserved. This is exactly what has been done.*

If a grave injury happens to the heart, the circulation is immediately suspended, and the body perishes for lack of it. Clever surgeons have been able in certain cases to repair the breach, and thus to put the whole machine on its feet again. In the same way they have succeeded in replacing a kidney, in strengthening an artery. Will they not soon succeed in suppressing death? Not in the least degree. These masterly operations can only prolong life; some day or other the mechanism will come to an end through the general wear and tear of its machinery, and its reconstruction will be irreparable.†

How much more harmonious and logical this theory will now seem to us, of the conservation in the individual of something which belongs to him, of a mechanism which builds up itself, and in part repairs itself by means of its reserves of energy, until the day when, its organs being completely developed, we see it subject to the laws which rule every material organization.

Thus, every living organism contains two parts: one which passes away, and is consequently subject to all the vicissitudes of the torrential flood which compels it to depart when scarcely settled in its place; the other which grows, which develops up to a limit imposed by the maximum of the organic functions, works in its own fashion, wins its right to citizenship, wears itself out, grows old, and dies on the premises ; on the one hand, if you like to express it so, a foreign element accidentally incorporated in the bodily substance, on the other the native element which lives in its own home, and occupies the city in right of ownership.*

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* Experiments by Dr. Carrel, (1906-8).

† "To sum up," writes E. Gley, "the power of reproduction of the human tissues is very limited, most of the organs can only be partially repaired by means of a cicatricial tissue which is almost the same in all the organs." (*Physiologie*).

When we reflect, however, we see that the problem is only partly resolved.

Our "material mechanism," we have said, has developed itself autonomously, each individual distinct from his neighbour: acquisitions, tendencies, habits have produced a distinct something which is part of *Myself* and of the foundation of my individuality. That is acknowledged. But what mysterious force has compelled it at the beginning to develope according to a particular law—in a word, where must we seek the origin of the differentiation of our "mechanism"?

Undoubtedly the influences of environment differ, and consequently different reactions take place. But anyone content with this as an answer would soon have to reckon with inextricable difficulties ; external influences can only very slowly and accidentally modify animal mechanism, and if one would discover the true reason of the specific differences, one must enquire of a much more powerful factor: Heredity.

Now what transmits heredity? The *germ*.

When you study the germ with the microscope, nothing reveals its future development, and yet it is this which will build up the individual. Here then we have a single grain of Matter which contains in itself not only the essential characteristics of the species and the race, but the special qualities of the ancestors of the family. The germ seems indistinguishable from others, yet the infant who will issue from it will be *himself* and nobody else; formed, so to say, from the paste of his parents, he will grow slowly or quickly, will be strong or rickety, his teeth will be in good or bad order, his hair black or white; his temperament sanguine or lymphatic; from his birth, even from his very conception, he has a tendency to gout, rheumatism, or gravel; his organic faculties will be the result of all the ancestral tendencies; he will be extremely sensitive, sweet and good-tempered, egoistical and surly, according to the family of which he is a member. Undoubtedly the soul can react, but the *tendency* will exist none the less.

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* Modern Physiology has excellently brought into relief this manner of looking at the problem, "It is the movement of assimilation and of separation which Cuvier called the 'tourbillon vital.' But it must be carefully observed that, contrary to what the biologists of Cuvier's time believed, it is not the essential living substance, the cellular protoplasm, which is carried away in this whirlwind, but only the materials elaborated by the protoplasm, and warehoused, in some sort, under the form of fat and glycogen which are thu incessantly destroyed and renewed." (Gley, *Op. cit.* p. 656).

The memory itself is transmitted by heredity, but this is not the case with the intelligence. How many "very ordinary" children have clever parents, because the intelligence is not an organic faculty, and therefore it can very truly be said: "In proportion as we rise in the hierarchy of our faculties, the *rôle* of heredity diminishes, without ever completely disappearing. It must persist even to the highest domain of the soul's activity, since the organism bears a part in the soul's operations, but the soul, we may say, frees itself more and more from bondage to its instruments." *

The germ once developed, the individual who will issue from it will add to this common fund, bequeathed to him by his ancestors, his own special character; that is, the common fund will undergo various modifications in detail. And this soil, cultivated by him in his own way, transformed according to his abilities and his virtues, he will bequeath, such as it is, in the germ transmitted to his children.*

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* Dr. Lefebre, L' *Hérédité*: Cong. Sc. des Cath. 1891. 7me Section, p. 184.

Apply this theory to animal as well as human descent, and you will understand why the instinct of beasts is transmitted in its entirety from parents to their offspring. The spider weaves its web as of yore, the ant cultivates the same grubs; beetles lay their eggs in the same corpses; centipedes, moths, bombex or ammophiles have not changed their clever way of paralysing their victims; on coming out of their shells ducklings plunge into the nearest pond, to the great alarm of the hen that has hatched them.

In the long run, variations in environment cause scarcely any modification in the operation of the instinct, which passes down unchanged through all the individual creatures. And this is the reason that a superficial observation might confuse animals with true automata.

Man, on the contrary, is eminently capable of perfection; endowed with intelligence and will, he can vary his actions, perfect his methods, produce good fruits from the talents which God has given him, and thus transmit to his descendents something of the aptitude in various ways that it has cost him much labour to acquire.

It is time to conclude these considerations. There exists in every human being an acquired matter which his parents have transmitted to him, a nucleus no doubt of sufficiently frail bulk, but sufficient to contain and sum up accumulated tendencies.

How can this microscopic germ include within itself the design and the organic properties of the man that is to be? That is a mystery which

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* "It is therefore especially to the proteid exchanges that we apply the word assimilation, this being *the production by the living being of a substance identical with its own*" (Ch. Robin). In this, consequently, consists the essential characteristic of life, and therefore also the secret of heredity.

Science is powerless to elucidate, but that matters little, since we know that it is on this same nucleus, now developed, that the human soul will build its body, increase and perfect it, group other elements around it according to a pre-determined plan belonging to itself, in such fashion that a material being will be constituted that cannot be confounded with any other.*

If then our physical identity has its root in so minute a part of the corporeal substance, can we, without talking nonsense, deny to the Creator the power of reconstituting some day, at the moment of the resurrection, this same identity which the soul has been able to acquire by its inherent powers, during the very short time granted it to perfect its individuality? Our ignorance on the subject of the constitution of the matter that belongs to each individual, forbids any objection on the part of incredulity; all such we can dismiss as irrelevant.

Our present Science, powerless as it is to solve the question, nevertheless teaches us various facts that show us that this reconstitution of the human body, even in its physical integrity, at the moment of the resurrection, is far from being an impossibility.

What are, in the last analysis, the molecules contained in the germ at the beginning but particles of ether? And what connects them? Again, ether, if we are to believe our present theories of Matter.

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* Every cell has the power to produce individuals of the same kind. "In beings of a given species, the newly formed living matter is specifically distinct in its chemical composition, in its structure and its functions, from that of living beings of any other species. In beings of the same species the cells of each tissue or organ create, similarly, the specific substances of their protoplasm, although all the organs are nourished by the same plasms; thus with materials common to all they have the power of forming each his proper and specific substance. The interior mechanism of this essential life-process escapes our observation." (Gley, *op. cit.* p. 657.)

In the face of such demonstration one asks how anyone can at the present day maintain the theory of transmigration! Cf. on the same subject, Armand Gauthier: *Cours de Chimie*, T. III, pp. 7, 8.

Now we have seen that the relations which unite the ultimate particles of the atom are not, properly speaking, corresponding with the conditions of our Space. We could imagine no disposition of them which would correspond with the reality; they would rather correspond to a qualitative order, and all our knowledge entitles us to believe that they belong, in fact, to a fourth dimension of Space.

The bond which unites particles of three dimensions could therefore reside outside of our Space; it would not on this account be less material and formed of material particles.

There is therefore no contradiction in admitting that these particles might, after death, serve to other uses. Why, when freed from the complex combinations in which they were confined by the substantial attraction of the body, should they not await the moment of the resurrection? Do we even know if materially they are adapted for other functions, and if it is not an impossibility for them to enter again into an organized substance?

On this point true Science teaches nothing; we are free, therefore, to make all possible suppositions, and yet it is very probable that we shall still be far from the true hypothesis?

Nevertheless, as we shall soon see, this theory of the organic nucleus placed in the space of four dimensions is that which in the present time agrees best with man's future condition, that is, with the prerogatives of the resurrection-body.

CHAPTER XVII

IMMORTALITY IN THE RESURRECTION

THUS all the so-called scientific arguments against our resurrection vanish so soon as we examine the conditions of our Identity in the light of the most recent researches of Science.

The resurrection of our body is possible ; nothing hinders God from restoring what He once created ; not only will this body which has belonged to us and been a part of ourself, be once again *informed* by our soul, but what constitutes our special *Matter*, what belongs to ourself alone and not to our brother or our neighbour, will again belong to us, and through the almighty power of God will once more commit itself to the dominion of the soul.

How wonderful is the profundity of the Christian dogma which thus harmonizes so marvellously with the very essence of our nature!

Man, as we have seen, is not simply an intelligence served by material organs; no more is he a pure spirit momentarily wedded to material elements ; the blending is more complete than this ; there is a substantial union between the soul and the matter through which it acts ; in the words of the philosophical definition, Man, whole and entire, is "the human compound."

The separation caused by death is therefore something abnormal, never willed by God ; the sin of the first man has disarranged the divine plan. This is simplv the teaching of Christianity, but it is too often forgotten; yet the words of the Scriptures are formally explicit on the point. Read again, especially, the luminous doctrine of St. Paul given to the Corinthians, which contains the whole substance of the Catholic dogma of the resurrection.

"For by a man [Adam] came death, and by a Man [Christ our Lord] the resurrection of the dead . . . But some man will say: How do the dead rise again? or with what manner of body shall they come? Senseless man, that which thou sowest is not quickened, except it die first. And that which thou sowest, thou sowest not the body that shall be, but bare grain . . . but God giveth it a body as He will: and to every seed its proper body. All flesh is not the same flesh . . . So also is the resurrection of the dead. It is sown in corruption, it shall rise in incorruption. It is sown in dishonour, it shall rise in glory. It is sown in weakness, it shall rise in power. It is sown a natural body, it shall rise a spiritual body."

What the Apostle understands by the "spiritual body" we shall see as this chapter proceeds. St. Paul contents himself with saying: "If there be a natural body, there is also a spiritual body;" the one is earthly, and the other heavenly, and "as we have borne the image of the earthly, let us bear also the image of the heavenly." And he adds: "Now this I say, brethren, that flesh and blood cannot possess the kingdom of God; neither shall corruption possess incorruption. Behold, I tell you a mystery: We shall all indeed rise again: but we shall not all be changed . . . and the dead shall rise again incorruptible." *

We shall rise therefore with our own bodies indeed, but they will have acquired new qualities, the chief of which, that which concerns us most, will be incorruptibility: the dissolution of the body will be

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* 1 Cor. xv, 21, 35-39, 42-44, 49-52.

henceforth impossible, according as it is written: "Death is swallowed up in victory. O death, where is thy victory?" The soul at the resurrection will resume those elements from which, according to the Creator's design, it should never have been separated. Upon this "body of death" the soul will impose the conditions of its own immortality. There will be no more passions to disturb us, for if in this life "the flesh lusteth against the spirit, and the spirit against the flesh," if flesh and spirit are in their tendencies "contrary one to the other, so that you do not the things that you would,"* it could not be so when your soul will possess the full knowledge of the truth.

To this glorious prerogative will be added that of which St. Paul speaks: our body "sown in dishonour, shall rise in glory, sown a natural body, shall rise a spiritual body." Does that mean that its constitutent elements will become spiritual or even immaterial substances? Not in the least. To support such a proposition would be to fall into Origen's error, † it would be to assert at the same time that our bodies were still, as they are now, *our own bodies*, and that their nature was radically altered.

If the body were to become spirit, rightly observed St. Thomas, man, to whose nature the body essentially belongs, would not really rise again at all. But since the glorified body will be wholly subject to the spirit, and the soul will no more have to combat corporeal passions, the Apostle could speak of the risen body as "spiritual."

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* Gal v. 17.

† Vigilius—Canones adversus Origenem (543). "Siquis dicit aut sentit, in resurrectionem, corpora hominum orbiculata suscitari, nec confitetur nos rectos suscitari, A.S." Cf. Conc. Toletanum XI (673) Adeodato Papa. "Hoc ergo exemplo capitis nostri confitemur vera fieri (*al.* vera fide) resurrectionem carnis omnium mortuorum. Nec in aëria vel qualibet alia carne (ut quidam dilirant) surrectos nos credimus, sed in ista, qua vivimus, consistimus, et movemur."

Besides, Christ, Who as He is the cause will also be the model of our resurrection, rose from the dead with a palpable body, truly material, although endowed with properties other than our bodies at present possess.

Let us read again in the New Testament the various passages which describe our Lord's apparitions after His resurrection: the properties of which we speak are indicated there in the clearest manner.

When on the morning of the first day of the week which followed the Death of Jesus, Mary Magdalene, Mary the mother of James, and some other women, came to the Tomb, they were astonished to find it empty; but on the same day Christ Risen appeared to them, as also to Simon Peter. Nevertheless, and even though the holy women had conversed with our Saviour, the other disciples gave no credit to this evidence, which seemed to them the result of an excited imagination. In spite of the reiterated promises of their Master, Who had announced His Resurrection so plainly to them, they continued to be incredulous.

It was then that, late in the afternoon, He appeared again to two disciples as they walked towards Emmaus, a little village sixty *stadia* * distant from Jerusalem, but they did not recognize Him at once.

"And they drew nigh to the town, whither they were going; and He made as though He would go farther. But they constrained Him, saying: Stay with us, because it is towards evening, and the day is now far spent; and He went in with them. And it came to pass, whilst He was at table with them, He took bread, and blessed and brake, and gave to them. And their eyes were opened, and they knew Him: and *He vanished out of their sight* . . . And rising up the same hour, they went back to Jerusalem: and they found the eleven gathered together, and those that were with them, saying: The Lord is risen indeed, and hath appeared to Simon. And they told what things were done in the way; and how they knew Him in the breaking of bread . . . *The doors were shut, where the desciples were gathered together*, for fear of the Jews . . . Whilst they were speaking these things, Jesus stood in the midst of them, and saith to them: Why are you troubled, and why do thoughts arise in your hearts? See My hands and feet, that it is I Myself; handle, and see: for a spirit hath not flesh and bones, as you see Me to have. And when He had said this, He showed them His hands and feet. But while they yet believed not, and wondered for joy, He said: Have you here anything to eat? and they offered Him a piece of a broiled fish, and a honeycomb. And when He had eaten before them, taking the remains, He gave to them . . . Now Thomas, one of the twelve, who is called Didymus, was not with them when Jesus came. The other disciples therefore said to him: We have seen the Lord. But he said to them: Except I shall see in His hands the print of the nails, and put my finger into the place of the nails, and put my hand into His side, I will not believe. And after eight days, again His disciples were within, and Thomas with them. Jesus cometh, *the doors being shut*, and stood in the midst, and said; Peace be to you. Then He saith to Thomas: Put in thy finger hither, and see My hands; and bring hither thy hand, and put it into My side; and be not faithless, but believing. Thomas answered, and said to Him: My Lord, and my God. Jesus saith to him: Because thou hast seen Me, Thomas, thou hast believed: blessed are they that have not seen, and have believed." *

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* About eleven kilomètres [" sixty furlongs "].

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* St. Luke xxiv, 28-31, 33-35, 36, 38-43. St. John xx, 19, 24-29. [The Scripture quotations throughout the volume, which the author transcribes from a French *Traduction de la Bible d' àpres les textes originaux*, by the Abbé A. Crampon, are taken in the the translation from the ordinary English Catholic version, involving trifling differences].

Thus in the person of the unbelieving Apostle our Lord has given us a great lesson. After the testimony of those who witnessed that they had seen Him Who was risen, Thomas had no reasonable ground for doubt. God does not demand of us a blind and unreasoned faith, but we are bound to believe His word as soon as its authenticity is demonstrated to us. Facts affirmed by numerous witnesses constitute a means for us to know the Truth, and a legitimate means, for it is within the limits of experimental knowledge.

These were not all the appearances of the Master after His Resurrection, but they are sufficient for our purpose. From the passages we have quoted, and especially from the sentences we have underlined, we must conclude that our risen bodies will not be purely spiritual: "A spirit hath not flesh and bones." Like our present bodies they will occupy a *place*, a real space. We need not ask therefore if we shall be "anywhere" after our resurrection; the question is resolved by the very fact.

Christ in fact revealed this to His disciples; "In My Father's house there are many mansions," that is, there will be room for all: "If not I would have told you: because I go to prepare a place for you. And if I shall go, and prepare a place for you, I will come again, and will take you to Myself; that where I am, you also may be. And whither I go you know. and the way you know." *

All these expressions that indicate place would be incomprehensible and even meaningless in reference to pure spirits. But it does not follow from this, that our bodies could not in the future receive other properties, even in the physical order.

We have seen that the risen Body of Christ could instantaneously become invisible to human eyes, that He could with utmost facilty transport Himself from one place to another, that in fine, He could enter a room the doors of which were closed.

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* St. John xiv, 2-4.

It must be therefore admitted that after the resurrection our bodies will possess the same prerogatives, and this has not failed to exercise the acute intellects of philosophers and theologians.

It is true that we cannot comprehend the mechanism by which such phenomena becomes possible; there is here, as St. Paul says, a veritable mystery, that is to say a series of phenomena beyond our present reasoning powers; but it is curious that our theories of Hyperspace prove that in themselves the properties of the glorified body are in no way opposed to reason.

Our spatial relations, as we have often had occasion to demonstrate, are purely contingent; now it is easy to prove that a modification in these relations in a definite direction would be sufficient, without any change in the ultimate elements of Matter, or even in the atoms, to endow the material substance with new properties, somewhat disconcerting to our present habits of life.

If we ask a child to prove the equality of the two triangles on page 62, he will not only be exceedingly puzzled, but, probably, neither would he see at a glance that the two figures are equal and can therefore be placed one upon the other; it would be the same with a being of a Space of only two dimensions. But a single movement in a higher Space—one of three dimensions—removes the difficulty.

By parallel reasoning, the geometer of a Space of three dimensions is no more perplexed to prove the equality of two symmetrical trihedrons which could not, as a whole, fit in with each other. These solid angles, usually unequal in our three-dimensional Space, are only a particular case of solid symmetrical figures.

Try to fit your right-hand glove to the left. Even if we suppose exact equivalence of size, you will find it an impossibility. And yet you could not doubt the equality, real and not conventional (although not admitted in our geometry), of your body with its image as reflected in the glass. Object and image are symmetrical; their details correspond exactly.

How does the reversal of the image take place? The scientist, by the help of geomatrical figures, will profess to explain it, but when we carefully consider the explanation, it turns out to be merely a statement of the fact: the real mechanism of the phenomenon will always escape us; we shall never arrive at understanding "why our visual ray appears to go through the glass and to see behind it the same form that stands in front of it." *

Just as, in plane geometry, in order to prove the equality of two symmetrical triangles (which is all that a "surface-being" could conceive), it is sufficient to imagine a rotation round one axis; so, when we conceive the idea of the fourth dimension, it will be sufficient to describe a rotation round a fourth axis of co-ordinates in order to be able to superimpose on each other our tetrahedrons, our spherical triangles, and spherical solids generally.

In what direction, you may ask, should we place this fourth axis? I know nothing about that, because I cannot imagine it, but the impossibility of forming an image noes not in the least imply the intrinsic impossibility of the existence of this new axis. We do not *imagine* any intellectual conception, any more than we imagine spiritual substances, the soul, or God Himself; yet we have proved that such substances exist.

More than this: strictly speaking, we do not imagine any substance whatever. It is quite futile to introduce sensible data to deny the possibility of a fourth co-ordinate. After all, as we have already remarked, (Chap. VII, p. 76), this fourth dimension of Space is only the possibility of material motion in a new direction.

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* Cf. M. Boucher, *op. cit.* p. 116.

A "linear-being" could not imagine one line being placed upon another; for him, motion within his Space would be possible in only *one* direction; a "surface-being" would imagine this easily enough, but he would only be able to *conceive* a triple possibility of motion. In the same way, immersed as we are in a world where only this triple possibility is visible, we cannot imagine the symmetrical adjustment of material volumes, that is, rotation round a fourth axis, but since it is not contradictory, it is possible; God can realize it according to the old scholastic adage: "God can do all that does not imply contradiction."

For the sake of those who have not grasped the bearing of this argument, I can give an idea of this rotation of a volume around a fourth direction, by a rough comparison.

It is an ordinary matter to clean a glove; when we do this we turn it inside out; in this case the glove so turned can be superimposed on the glove belonging to the other hand which has not been turned. But the analogy is far from perfect, since the surface has passed from the exterior to the interior, which could not happen in the geometrical ideal.

From these considerations extremely important consequences follow:

(1) First, we can infer the possibility of a material substance, say our body, existing in a hyperspace. Besides, there is nothing mysterious about that; for this to be the case, all that is required would be that all the molecules or constituent parts of our body should be able to move in a fourth direction; in fact, that the number of our present spatial relations should be increased. In other words, if all our mole-

cules could acquire one more relation, we should be *ipso facto* in Hyperspace.

(2) We have seen that at present all modern Physics lead us to believe that gravitation works according to a fourth dimension of Space ; if ether is the cause of this we can most certainly say that, in relation to it, material bodies are transparent, since the ether can communicate its vibrations without having recourse to the three known dimensions.

Besides, whether the ether is the cause or not, the conclusion is logically the same, and it matters little whether we can decide what substance it is in relation to which our bodies are thus transparent ; what appears certain is that such a substance exists.

We must then conclude that if our body possessed hyperspatial properties, in addition to those of which we are aware, all material substances would become transparent to us. No surface would arrest our sight ; it would penetrate to the interior of material masses as we now penetrate into the interior of surfaces by a property unimaginable to a plane-dweller.

(3) Besides—and this is a more unexpected deduction—if our bodies were constituted according to the laws of Hyperspace, they would not be confined within a mass of three dimensions any more than we are now confined within the interior of a circle. Here is something that explains wonderfully that property of risen bodies which seems at first sight so stupefying.

And here I must defend myself from a possible accusation. I do not say that our risen bodies will be framed, in fact, according to the laws of Hyperspace ; I do not wish to affirm anything of the kind, and I leave to others the task of examining whether such a hypothesis corresponds to the known facts ; but no one can hinder me from declaring that a being framed according to those laws would possess the remarkable geometrical and mechanical property of not being hindered by the surfaces which now arrest our movements.

If we confined such a being in a closed room he could instantly disappear from our sight. And yet, you will say, since no aperture exists, by what means could be escape ?

If a philosopher of former days had asked such a question I would have excused him readily, for a mathematician of to-day the question has no meaning ; I might as well ask where a square or a circle exists.

Since our hyperspatial being can make use of a fourth direction in Space, he has no need to recognize a surface, or to use the three ordinary directions of Space in order to escape : he *goes out* by a fourth direction, absolutely, without touching the surfaces which confine a being in a Space of three dimensions. In fact, the supposition made above should not be expressed in this way at all.

I was expressing it wrongly to say : "Let us confine such a being in a closed room," since the word *confined*, we have just demonstrated, is a concept quite inapplicable to the circumstances.

(4) The transport of a hyperspatial being from one place to another would not be effected instantaneously, but that the conditions of motion would be changed there can be no doubt, although it would be difficult to determine them.

Such a problem as this, which has not so far been attacked, seems however to be capable of solution. We are even now able to determine graphically the geometrical properties of regular bodies to four and to *n* dimensions : summits, precipices, intersections, and so forth ; but then these figures are no longer polyhedrons ; they have been named polyhedroids. They are derived from the tetrahedron, the hexahedron, the octohedron, and it is demonstrable that they exist for all "Spaces."*

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* Cf. Jouffret, *op. cit.* and Mr. Stringham's admirable paper, "Regular Figures in a Dimensional Space," in the *American Journal of Mathematics*, Vol III.

But since Cinematics, or the science of Motion, is after all but a department of Mathematics, we need not despair of some day seeing a clever mathematician take up the question, and arrive at some interesting conclusions as to the conditions of Motion in Hyperspace.

Now, what present Science authorizes us to infer from a study of the facts is that we bear within us, at the very heart of our corporeal substance, the germ of a hyperspatial provision, since such a provision the ultimate particles of Matter appear to offer to our investigations.

It is therefore not contrary to facts to admit, from a scientfic standpoint, the possibility of every part or our body realising such a provision.

Once more I do not assert that our risen bodies will appear under such conditions; I simply assert that if God, at the moment of our resurrection, should add these hyperspatial properties to those which our bodies now possess, then according to the Apostle's words "we shall be changed";* we should necessarily possess the characteristic qualities of Christ's Body after His Resurrection.

This statement does not pretend to explain the mystery proposed to our faith, but it is enough to show that, in this point also, the mystery does not contradict our reason.

This gathering together of the glorified bodies around our Lord suggests to our curiosity another question of absorbing interest: Of what nature will be this place of happiness, and where will it be situated?

Revelation tells us nothing positive with regard to this, but we ought not to pass over in silence some most suggestive passages which have for long exercised the acute minds of our theologians.

"I saw," writes St. John, "a great multitude, which no man could number, of all nations, and tribes, and peoples, and tongues."*

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* 1 Cor. xv. 52

"And I saw a new heaven and a new earth. For the first heaven and the first earth was gone, and the sea is now no more. And I, John, saw the holy city, the new Jerusalem, coming down out of heaven from God, prepared as a bride adorned for her husband. And I heard a great voice from the throne, saying, "Behold the tabernacle of God with men, and He will dwell with them. And they shall be His people; and God Himself with them shall be their God. And God shall wipe away all tears from their eyes: and death shall be no more, nor mourning, nor crying, nor sorrow shall be any more, for the former things are passed away."†

How should we interpret this? The literal sense seems the best. After the end of this present world God will create new heavens and new earths where His elect will reign in everlasting happiness. We have seen that, logically, risen bodies must occupy a place, and it is for them and their benefit that the Creator will prepare a new universe, "future worlds, the seed of which, as it were, we already catch a glimpse of in unfathomable, space," says M. de Kirwan.§

We find this announcement of a new creation in various parts of the Scriptures, expressed in similar terms. First, let us listen to Isaias:

"For behold I create new heavens, and a new earth. . . But you shall be glad and rejoice for ever in these things which I create."**

"For as the new heavens and the new earth, which I will make to stand before Me," saith the Lord: "so shall your seed stand, and your name."*

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* Apoc. vii. 9.

† Apoc. xxi. 1-4.

§ Ch. de Kirwan: Bible et Science, Terre et Ciel, p. 61. (Blond et Cie, Paris).

** Isaias lxv. 17, 18.

Then St. Peter also proclaims a renewal of the Universe; after alluding to the end of the world by fire the Apostle writes:

"Seeing then that all these things are to be dissolved, what manner of people ought you to be in holy conversation and godliness? Looking for and hasting unto the coming of the Day of the Lord, by which the heavens being on fire shall be dissolved, and the elements shall melt with the fervent heat. But we look for new heavens and a new earth according to His promises, in which justice dwelleth.†

St. Paul also tells us of God's purpose "in the dispensation of the fulness of times, to re-establish all things in Christ, that are in heaven and on earth."§

In whatever way God may realise His designs, we know that He will only have our supreme good in view; to know this is all that really matters; this is the thought that must ever be present to our minds if we would use the means to attain the eternal reward and to merit our glorious destiny.

We are now in a position to give a complete answer to the question which forms the title of this book: "What shall we become after Death?" One phrase sums up the resolution of the Great Riddle: *Credo resurrectionem;* I believe in the resurrection of the dead, in my own resurrection.

How could we find a mystery more consoling, more consistent with our secret aspirations, more honourable to the integrity of our nature? Could my future happiness ever attain its plenitude if, notwithstanding the survival of my soul, I were to remain for ever separated from my body?

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* Isaias lxvi. 22.

† 2 Peter iii. 11-13.

§ Eph. i, 10.

Has not this body suffered along with my soul, has it not received all physical impressions and endured all physical ills, and since it has shared the pain, why should it not share the glory?

Besides, is it not with this body and by its means that my soul has taken cognizance of the material world so as to arrive gradually at the knowledge of the laws which governor it? It is through our multiform sensations that we catch a glimpse of the harmonies of the Universe:

Harmonies of the Light which as the sun is setting tints the high mountain summits, darkens the deep blue of the sky, to light up, a little afterwards, these flaming stars which are the objects of our study through our mighty telescopes.

Harmonies of the sea, the waves of which, now calm, now stormy, are a true image of men's passions.

Harmonies of our terrestrial landscapes, which unfold themselves in infinite variety from the Equator to the Poles: burnt-up desert wastes, majestic forests, precipitous mountains, green valleys and meadows, brooks of living water, cascades, impetuous torrents, fertile banks of great rivers, sandy coasts, fiords running far into the land, the bare and frozen immensity of the Polar regions; what objects for the poet's dream and meditation, what subjects for the study of the artist and the man of science!

Harmonies of the mineral and inorganic world, into which penetrates the eye of the geologist, the chemist, and the natural philosopher: Matter in motion through an endless energy; the affinities and activities of the atoms unceasingly at work in the renewal of nature; material forces ever seeking their equilibrium even at the cost of tremendous revolutions which transform the aspect of our world like a sculptor moulding the clay to the shape of his next creation; Matter, blind indeed, but obedient and submissive to the laws imposed on it by its Creator.

Harmonies of the vegetable world and the animal kingdom, all unsuspected by the unlearned, but which ravish the naturalist and reveal to him everywhere the imprint of Uncreated Intelligence.

Harmonies of Nature which shine forth in the infinitely little, no less than in the huge sun which rolls its fiery furnace to the confines of our stellar horizon.

Harmonies of visible things of which the soul has caught a glimpse across the prism of its bodily impressions, which have made possible its higher flights and opened to it the way to the invisible.

All these means which man possesses in this life for arriving at the conception of the true Infinite, of the Supreme Ideal, in one word, of the Absolute—are we obliged to throw them overboard, to disown them, when we cross the threshold of the Beyond? Are they not part of *Myself*, have they not contributed to form and to preserve our own individuality? Are not our moral habits acquired possessions? Have they not required of our soul a persevering will which has moulded our body by curbing its lower instincts, and has prepared it by continual sacrifices for that supernatural end which God has in store for it?

Although our resurrection is a purely free gift of our Creator, do you not feel that everything within us calls for it, that all our being tends towards it as towards the most harmonious destiny we can conceive?

This life is but a testing-time; rejoice then, it will shortly end. Then from this skeleton, invested once more with flesh, you will contemplate God, your eyes will see Him,* and to share that same glorious immortality your brother too shall rise again at the last day, and all who are dear to you and whom you have loved on earth. And you shall see them again beyond the tomb, for they are part of yourself and intimately linked to your personality.

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*Job xix. 26, 27.

Is it not upon our mother's knee that we learnt to catch a glimpse of God and of the divine beauty of Jesus Christ? Was it not she who, by the teaching of an all-divine doctrine, opened our hearts to the action of grace, and taught us to lisp our first act of love to our Sovereign Master?

And from this maternal work, so tender and so persuasive, could we disjoin that of the head of the family? Has not our father helped, of course in a more virile way, to guide our steps in life, to make us love virtue, to incline our will towards the Good that leads to the eternal Truth?

For myself—let me be allowed this personal reminiscence—can I ever forget with what enthusiasm my father used to talk to me about the wonders of Nature, in order to let me have a glimpse, behind her splendours, of the beauty of Him Who has disposed her with so much order and wisdom. It was his words which, when I was a child, transported my mind at the sight of the sublime mystery of Creation; it was he who directed my first flights in those remote regions where worlds move through space, where the nebulæ still chant Creation's hymn, in their majestic progress, like the Matter of chaos beneath the mighty breath of our Lord God.

Do you now grasp what intimate and mysterious ties join us to those who are no longer amongst us? Their image, which we cannot forget, so completely forms part of our own personality that our *self* would appear incomplete if we were to banish all the thoughts and feelings which they have aroused in us, and the memories they have left to us. "If Love is strong as death,"* how should this foundation virtue of family life and human society stop short at the grave?

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* *Cant.*, viii, 6.

This wife who has loved, who has shared with the father of her children the sacred joys of their home, the inevitable sufferings which family life must bring; sacrifices, sickness, anxiety as to the future; this mother, who has carried in her bosom the child of her love, who has sung him to sleep in his cradle, who has watched so often at his bedside fighting for his life; this woman who has closed the eyelids of him whom she knew to be flesh of her flesh and the reflection of her own soul, who has clothed her child in the white robe of the brides of death and laid her body in the consecrated earth where she awaits the resurrection; and the betrothed who has lost her whom his heart had chosen, when the priest of the Eternal was about to seal for ever the union of their souls; and all those forsaken ones, whose childhood never knew a mother's caresses or tears of joy; have not all these a right to the sublime hope that they will see again or come to know those of whom death has deprived them?

If the future life has in store for us supreme beatitude, as we have shown, how can we doubt for a moment that in the home of eternal love we shall be united to our beloved by ties infinitely stronger and more puissant than those of flesh and nature?

A consoling thought indeed, which the word of Christ itself confirms: "If I shall go and prepare a place for you, I will come again, and will take you to Myself; that where I am you also may be."*

Then will be realized the promise of the apostle, for we shall love one another with the same love, in God.†

---

* St. John, xiv. 3.

† 1 St. John, iv. 12.

And having reassured His disciples of their reunion in Him, He adds: "Whither I go you know, and the way you know." Thomas saith to Him: "Lord we know not whither Thou goest; and how can we know the way?" Jesus saith to Him: "I am the Way, and the Truth, and the Life."*

"I am the Resurrection . . . he that believeth in Me, although he be dead, shall live: and every one that liveth, and believeth in Me, shall not die for ever."†

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* St. John, xiv. 4-6.

† St. John, xi. 25, 26.

THE END

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INDEX

Accidents, 31, 100 sqq.
Action, direct and indirect, 152, 153.
Aliment, necessary, 202.
Ant, example of life-processes, 114.
Atoms, 25, 35, 40, 93.
  „ not "indiscernibles," 187.
Atomism, 83, 101.

Balmès, 100, 110, 177.
Beatific Vision, 173.
Bichet, X. (definition of life), 112.
Bilocation, 155-158.
Blanc, Elie, 103.
Body, The, is it renewed? 190 sqq.
  „ „ , renewal of, an unproved hypothesis, 195 sqq.
Braig, M. l'Abbé, 80, 81.
Carbon, 81-83, 85.
Consciousness, simultaneous relations entered into by, 136.
Contact and Distance, *vide* Action.
Coulomb's Law, 97.
"Curve-Space," 56.

Darwin, 191.
Death, The Great Riddle, 12.
  „ not the end, 12.
De Lapparent, A., 139.
Delbœuf, J., 126, 194, 195.
Descartes, 43, 101, 127, 147, 171.
De Vries, Hugo, 191.
Duhem, P., 84.

Electricity, Hertz on, 79, 80.
Electrons, 27, 30, 33, 34, 39, 93.
Elliptical Geometry, 57.
Epicurus, 101.

Ether, 40, 80, 86.
„ mechanical theory of, 86, 91, 92.
Euclidian (Plane) Geometry, 49-52.
Extent, 40, 47, 48, 108 sqq., 163.

First Cause, A, scientifically necessary, 165
Flourens, 192, 3.
Force, true reality of Matter, 81, 103.
Fourth Dimension, 64-67, 76, 77, 85, 88, 89, 91, 92, 152, 221, 222.
Future Life, Belief in, at base of all religions, 12.

Galileo, 43, 95.
Generalising, a faculty purely of the soul, 145.
Geometry, *vide* Elliptical *and* Euclidian.
Gley, E., 150, 209, 212.
Gravitation, 87, 88, 97

Hearing, sense of, 17, 18.
Helmholtz, 86.
Hemiphlegia, 204, 205.
Heredity, 209 sqq.
Hertz on Electricity, 79, 80.
Hinton, C. H., 65.
Hydrogen, 81.
Hyperspace, 69 sqq., 85, 154, 222-225.

Idealism *versus* Subjectivism, 22, 23, 36.
Incorruptibility. 215.
Inertia of Matter, theory of, 95, 96.
Intelligence, not in the frontal lobes, 149 sqq
„ not transmitted by Heredity, 210.
Intuition, no pure intellectual, 172.

Jennings, H. S., against tropistic theory, 122.

Kant, 45.
Kauffman, experiments *re* Electrons, 34.
Kelvin, Lord, 86.
Keppler, 171.

Lamarck, 191.
Lateran Council, Fourth, on the resurrection of the body, 185.
„ „ Fifth, definition of the soul, 154 *note.*
Lazarus le ressuscité, L. Mercier's poem quoted, 169.
Lechalas, G., 104, 111.
Leibnitz, 101, 187.
Lobatschewsky, 53, 57

Lodge, Sir Oliver, 86.
Loeb, J., 121.
Lucretius, De Natura Rerum, 91, 92.

Mass (quantity), 31, 32.
Matter, modern conceptions of, 79.
  „ "ponderable" and "imponderable," 29.
  „ unity of, 24.
Maxwell, Clerk, 79.
"Maximum Stability," 115.
Mechanics, inadequacy of, 33.
Metageometry, 56, 158.
Metempsychosis, 159, 160, 168.
Mexican Salamander, 86.
Mie, Dr. Gustave, 98, 99.
Molecules, *vide* Atoms.
Morality, Absolute in God. 166, 167.
Multiplicity, a characteristic of material bodies, 93.
Munk, on the seat of the intelligence, 150.

Newcomb, S., 59, 75.
Newton, 87.
Nutting, P. G., 87, 88.

Ollier, L., experiments of, 195.

Papin's Receptacle, 188.
Pascal, 86.
Pavlov, J. P., 122-125.
Philosophy, Scholastic, 101, 102.
  „ Thomist, 101, 115.
Physics, Modern, 84.
"Plane-dwellers" (space of two dimensions), 61-68, 90, 91, 122.
Poincaré, H., 137.
"Primary Matter,' 101.

Radium, 27, 30.
Ramsay, Sir William, 27.
Resurrection of the Body, 180 sqq.
  „ consistent with human aspirations, 227.
  „ Fourth Lateran Council on, 185.
  „ in conformity with Science, 214.
  „ Reunion in the, 230, 231.
Riemann, B., 44, 57, 84.

Saccheri, Fr., 53.
Sensation, 130 sqq.
Sight, sense of, 18-21.

Sixth Sense, absurd to deny possibility of, 16.
Soul, The, 128 sqq.
  „ „ cannot die, 142 sqq.
Space, 41 *et passim.*
  „ non-existent in itself, 44.
  „ properties of, not absolute, 68.
Stereochemistry, 82 sqq.
Subjectivism, *vide* Idealism.
Substance, 31, 94 sqq., 172.

Taine, 186.
Text-books, popular scientific, condemned, 149.
Time, 161-164.
  „ idea of infinite, absurd, 164.
Trinity, The Most Holy, 173 sqq.
Tropisms, Theory of, 121 sqq.
  „ „ „ irreconcilable with phenomena, 123 sqq.
Ultimate Particles, 26, 27, 40 *et passim.*
  „ „ unextended, 101.
Understanding, phenomena of, 146.

Van t'Hoff, 82.
Viète, on numbers, 171.
Vitalism *versus* Mechanism, 115 sqq.

Weber (physiologist), 106.
Will, phenomena of, 146.

X Rays, 19.

Zeno's paradox 42 –
Salamander 126 ff.

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Moreux, Theophile,
What shall we become after death?